ELECTRICAL REVIEW

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Making motors to suit the drive and the conditions of service is something L.S.E. have been doing rather well for more than seventy years. As a result, quite complex requirements are often satisfied exactly by the right combination of standard L.S.E. motor and L.S.E. control gear, without the need for costly new development.

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STARTING PANELS for N-S variable speed a.c. motors
THE L.S.E. FLOATING TYPE MOTOR FOR ROLLER TABLE DRIVES
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THE L.S.E. "TRISLOT" HIGH TORQUE LOW CURRENT SQUIRREL-CAGE MOTOR

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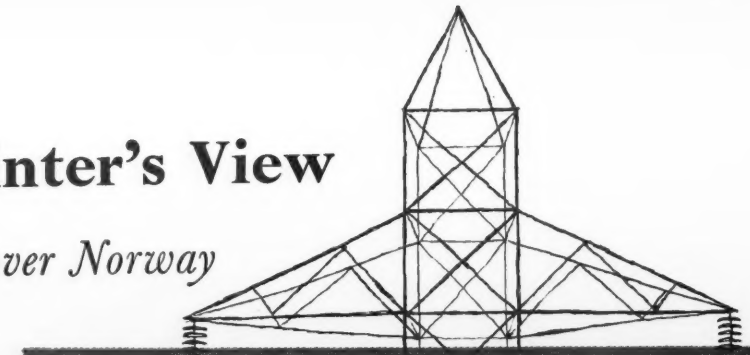
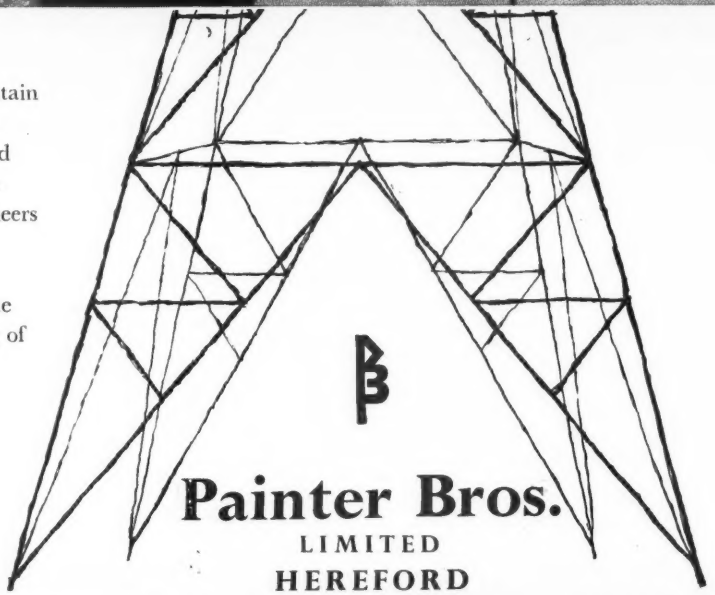
RWICH MANCHESTER

The Painter's View

New Way over Norway



Stretching through Norway's mountain valleys a line of steel towers carries comfort and power to the farms and fjords—electricity to the roof of the world. Throughout the world engineers know that they can rely on towers made by Painter Brothers, for 30 years of specialised experience in the fabrication and hot-dip galvanising of mass produced structures, coupled with the knowledge gained from the operation of their tower testing plant, go behind every ton produced—that is why Painter Brothers' towers are Towers of Strength.



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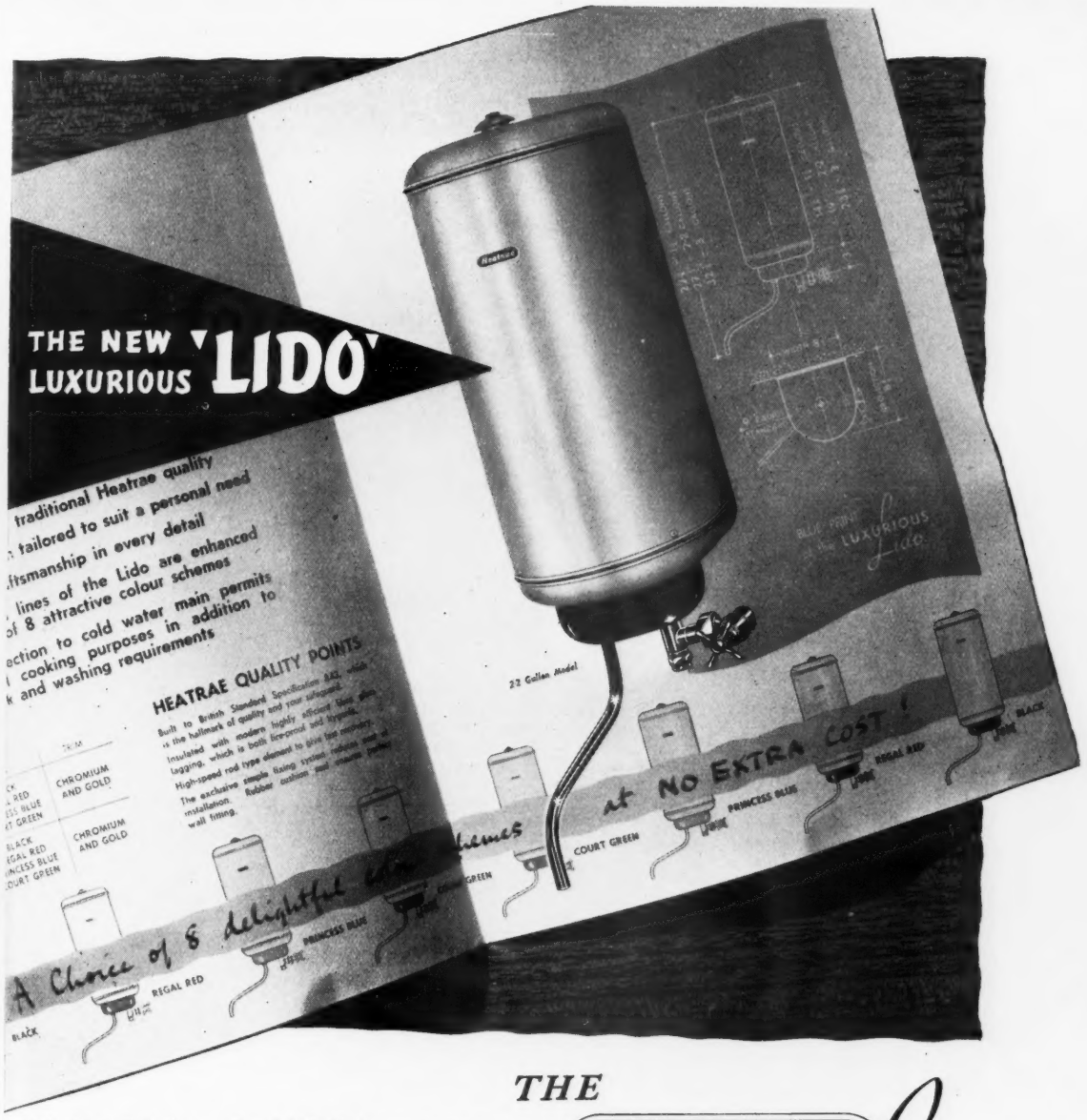
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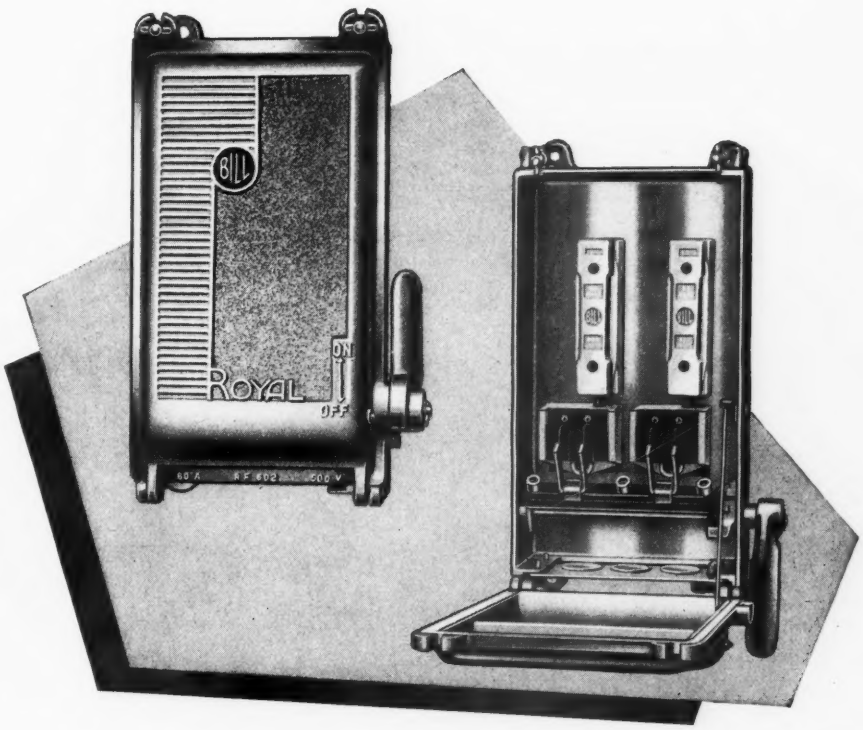

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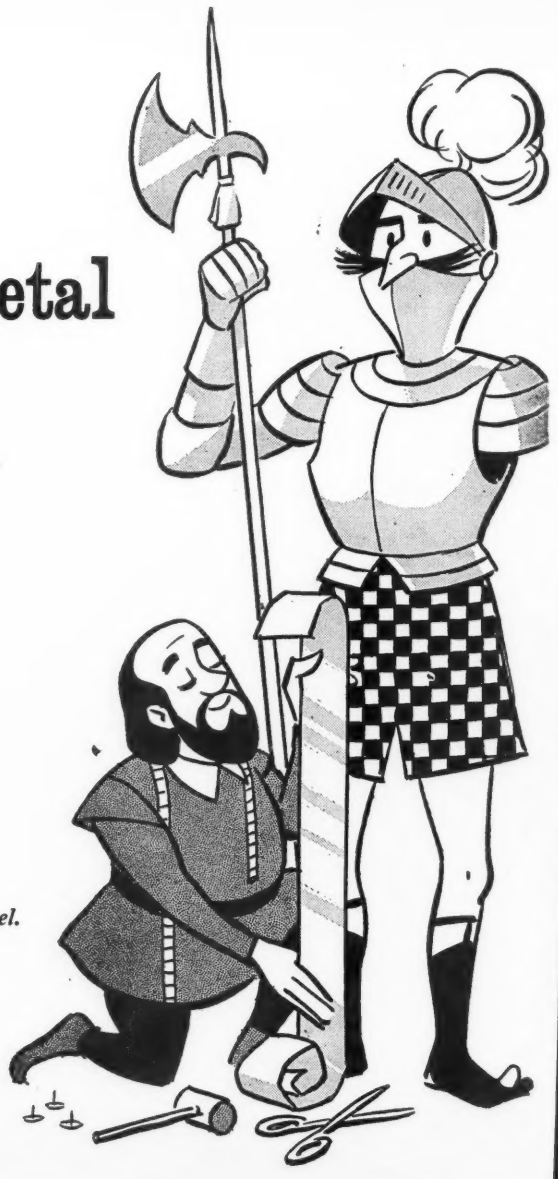
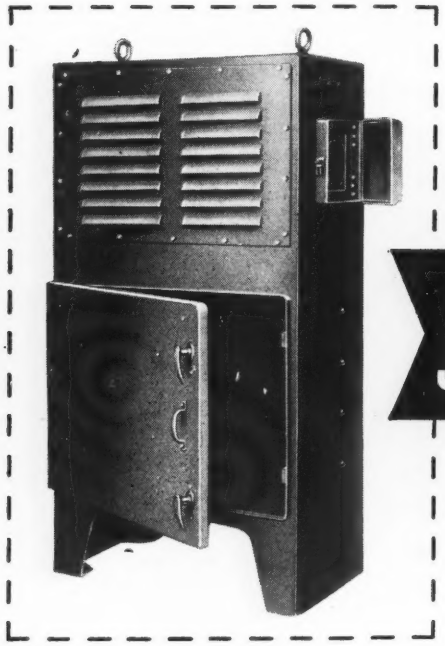


Illustrated here is a switch-gear housing, an example of one of our many fabrications in sheet steel.



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What we mean by a dependable drive

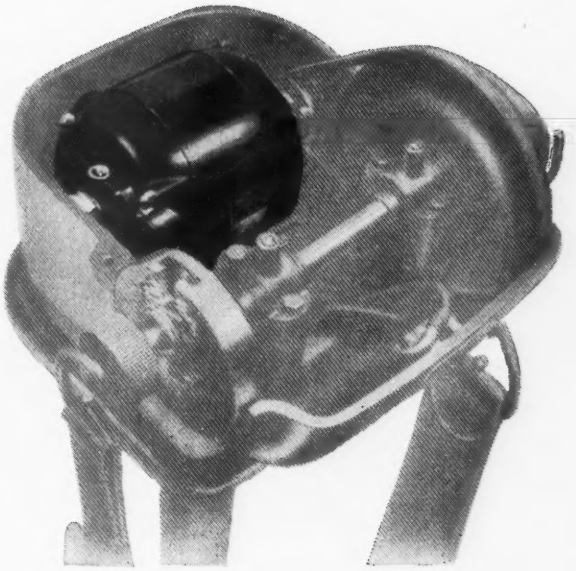
You can fit a BTH fractional horse-power motor, confident that it will last as long as the machine that it drives. This is the kind of dependability that is achieved only when excellent design is combined with exceptional mechanical and electrical characteristics.

With BTH, a tradition of dependability is a natural outcome of their ' big motor ' experience, such as 14,000 s.h.p. motors for marine propulsion, 2,500 h.p. colliery winders, 1,000 h.p. railway locomotives, 10,000 h.p. motors for driving steel mills.

In applications like these, where failure would mean dislocation of public services, loss of production or questions of life and death, BTH machines have been chosen for dependability all over the world. BTH 'Fractionals' are based on the same principles and built to the same exacting standards as these large machines.

Some notable features of building BTH ' Fractionals '

- Core, commutator and fan are integral with shaft—and virtually indestructible in service.
- Accurately-ground shaft made of specially selected steel to resist fatigue and wear.
- Core insulation and generous use of inter-coil insulation is such that high mechanical and electrical strength is obtained. Conductor insulation specially treated before *and* after winding.
- Rigidly controlled impregnation with varnish; windings bonded so tenaciously that they are practically indestructible in service, and impervious to atmospheric moisture.
- Fan is designed to produce maximum cooling without noise, and brushes for DC machines are specially selected for long life and quiet operation.



Here's dependability! During nearly thirty years' daily use, the BTH motor in this oscillating massage machine has been giving trouble-free service.

A ' Fractionals ' advisory service for designers
BTH engineers are always ready to advise on the choice of a fractional. It pays to call them in at the design stage and get the right motor for the job.

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page 600

ECONOMIC BOILERS

Boiler by Stockton Chemical Engineers & Riley Boilers, 15 ft. over tubeplates × 6 ft. int. dia. Evap. 4,000 lb. hr. at 212° F. W.P. 225 lb.sq.in.

Self contained Double Pass Boiler by Rankin & Blackmore, 14 ft. 6 in. overall × 12 ft. over tubeplates × 7 ft. 3 in. dia. Evap. 4,000 lb. hr. F. & A. 212° F. Pressure 250 lb.sq.in. Single flue fitted Hodgkinson Low Ram Stoker. Steel Chimney 27 in. dia.

Two Super Economic Boilers by John Thompson, treble pass type, 14 ft. over tubes × 9 ft. 6 in. diam. × 19 ft. overall. Evap. 9,500 lb. hr. at 212° F., when stoker fired, 9,900 lb. when oil fired. W.P. 120 lb.sq.in. Fitted Superheater to give final temp. 445° F.

Self contained Economic Boiler by Edwin Danks, 13 ft. 6 in. overall × 10 ft. 6 in. over tubeplates × 5 ft. 6 in. diam. Evap. 2,000 lb. W.P. 60 lb.sq.in. With Worthington Simpson Boiler Feed Pump.

Single pass Economic Boiler by Foster, Yates & Thom, 22 ft. 9 in. overall × 16 ft. over tubeplates × 10 ft. 6 in. diam. Evap. 12,500 lb. hr. at 212° F. W.P. 150 lb.sq.in. Fitted Superheater giving final temp. 445° F. and John Thompson Triumph Shovel Stoker.

Three Treble Pass Economic Boilers by Edwin Danks, 10 ft. 6 in. diam. × 11 ft. 6 in. over tubes × 11 ft. 6 in. overall. Evap. 11,620 lb. hr. at 212° F. fired with good coal or 12,200 lb. hr. at 212° F. when oil fired. Steam drum 5 ft. × 42 in. diam.

Six self contained Treble Pass Boilers by Marshall, 9 ft. 6 in. over tubeplates × 12 ft. overall × 8 ft. diam. Evap. 4,250/5,200 lb. W.P. 100 lb.sq.in.

Self contained Boiler by Danks, 11 ft. over tubeplates × 6 ft. dia. Evap. 2,500 lb. hr. W.P. 150 lb.sq.in. Fitted 'Rotamiser' Oil Burning equipment by Combustions, Ltd., Mowbrey controls, Weir Feed Pump 600 g.p.hr. and Steel Chimney 2 ft. dia. × 55 ft. with guys.

New Size No. 6 'Farratube' Economic Boiler, 13 ft. 9 in. over combustion chamber × 10 ft. 6 in. over tubeplates × 6 ft. diam. Evap. 2,800 lb. at 212° F., or 2,340 lb. at 60° F. W.P. 100 lb.sq.in.

MULTITUBULAR BOILERS

Size 22 Cochran Vert. Boiler, 18 ft. plus 4 ft. skirt × 8 ft. 6 in. diam. Evap. 4,960/6,600 lb. hr. easy/heavy steaming with feed at 50° F. W.P. 105 lb.sq.in. Hand coal fired. Can be converted to Oil burning.

Size 21 Cochran Boiler, 16 ft. 6 in. × 8 ft. diam. Evap. 4,320/5,700 lb. with feed at 50° F. W.P. 105 lb.sq.in.

Size 14 Cochran Boiler, 15 ft. 6 in. × 6 ft. diam. Evap. 2,000/2,600 lb. W.P. 100 lb.sq.in. Fitted extension skirt for Oil Firing equipment. Including Motorized Feed Pump, two Mowbrey Control Switches and 45 ft. × 21 in. diam. Chimney.

Size No. 19 Cochran Boiler, 15 ft. × 7 ft. diam. Evap. 3,020/4,000 lb.sq.in. W.P. 100 lb.sq.in. Heating surface 600 sq. ft. Hand fired.

Size No. 45 Ruston Thermax Boiler, 15 ft. × 6 ft. 6 in. diam. Evap. 3,400/4,500 lb. hr. at 60° F., or 4,080/5,400 lb. hr. at 212° F. W.P. 120 lb.sq.in. Hand coal firing.

Size 35 Ruston Thermax Boiler, 15 ft. × 6 ft. diam. Evap. 2,550/3,380 lb. at 60° F., or 3,060/4,050 lb. at 212° F. W.P. 120 lb.sq.in.

Clarkson Vert. Thimbletube Boiler, size BATOO/320, 14 ft. 6 in. (incl. 2 ft. skirt) × 5 ft. 6 in. diam. W.P. 120 lb.sq.in. Evap. 2,300 lb. at 60° F., 2,800 lb. at 212° F. With Feed Pump and 50 ft. steel chimney.

Size No. 16 Cochran, 14 ft. × 6 ft. 6 in. dia. Evap. 2,360/3,100 lb. hr. W.P. 100 lb.sq.in.

Size No. 16 Cochran, 14 ft. plus 2 ft. 6 in. extended skirt × 6 ft. 6 in. dia. Evap. 2,360/3,100 lb. W.P. 150 lb.sq.in.

Cochran No. 14 Vert. Boiler, 14 ft. × 6 ft. diam. Evap. 2,000/2,600 lb. W.P. 105 lb.sq.in. Hand coal fired.

Size 30 Ruston Thermax Boiler, 14 ft. × 5 ft. 7 in. diam. Evap. 2,110/2,820 lb. at 60° F. or 2,530/3,380 lb. at 212° F. W.P. 120 lb.sq.in. Fitted Riley No. 10 Underfeed Stoker motorized 400/3/50 with Mowbrey auto. control. Worthington Simpson horiz. duplex. Feed Pump with Ronald Trist Thermofeed.

Cochran No. 15 Vertical Boiler, 13 ft. 6 in. × 6 ft. 6 in. dia. W.P. 155 lb.sq.in. Evap. 2,360/3,100 lb.

Cochran No. 12 Vertical Boiler, 12 ft. 6 in. × 6 ft. dia. W.P. 180 lb.sq.in. Evap. 1,880/2,500 lb. With Ronald Trist Thermo Feed.

Size No. 12 Cochran Vert. Boiler, 12 ft. 6 in. × 6 ft. dia. W.P. 160 lb.sq.in. Evap. 1,880/2,500 lb. With Riley No. 10 underfeed Stoker and Ronald Trist Thermo feed.

Two No. 11 Cochran Hopwood Boilers, 11 ft. 6 in. × 5 ft. 3 in. diam. Evap. 2,000/2,700 lb. hr. at 60° F. W.P. 120 lb.sq.in.

Size No. 16, Ruston Thermax Boiler Size 11 ft. 3 in. × 4 ft. 7 in. diam. Evap. 1,250/1,500 lb. at 60° F., or 1,650/1,980 lb. at 212° F. W.P. 120 lb.sq.in.

Size No. 16 Spencer Hopwood Vert. Boiler, 10 ft. 9 in. × 4 ft. 9 in. diam. Evap. 1,550/1,860 lb.hr. at 60° F., or 2,060/2,470 lb. hr. at 212° F. W.P. 120 lb.

Size No. 14 Ruston Thermax Boiler, 10 ft. 6 in. × 4 ft. 4 in. diam. Evap. 1,000/1,340 at 50° F., and 1,200/1,610 at 212° F. W.P. 120 lb.sq.in. Accessories include Leo motorized Feed Pump with Mowbrey controller, and Unicalor underfeed Stoker.

Size No. 10 Spencer Hopwood Boiler, 10 ft. 6 in. × 4 ft. diam. Evap. 1,160/1,550 lb. at 60° F. W.P. 120 lb.sq.in. Arranged for Oil firing with semi automatic 'Nortex Cup' atomiser by Urguhart. Accessories include Oil Heater, Fuel Tank, Boiler Feed Pump and Chinmey.

No. 7 Cochran Boiler, 10 ft. 3 in. × 4 ft. 9 in. dia. Evap. 1,030/1,370 at 50° F. W.P. 105 lb.sq.in.

Size No. 14 Cochran Boiler, Size 14 ft. × 6 ft. diam. Evap. 2,400 lb. hr. W.P. 105 lb.sq.in. Fitted single Clyde Oil Burner.

Two size 7C Cochran Kirke patent 'Sinuflo' Gas fired Boilers, 7 ft. × 3 ft. diam. Evap. 760 lb. hr. W.P. 125 lb.sq.in. Gas consumption each Boiler 10.25 therms hr.

WATERTUBE BOILERS

Size No. 8 Fraser & Fraser Watertube Boiler. Evap. 2,500 lb. hr. at 120 lb.sq.in. W.P. With Oil burning equipment by Urguhart, Ltd., also Fuel storage Tank for 2,750 gal., Boiler Feed Pump and 60 ft. Chimney.

Two Babcock & Wilcox Boilers, W.I.F. type, arranged as pair, heating surface 3,580 sq. ft. ea. Evap. 12,500 lb. ea. normal, up to 16,000 lb. forced. W.P. 170 lb.sq.in. Superheater 396 sq. ft. heating surface each has two horiz. steam drums 24 ft. × 3 ft. 6 in. dia. With Babcock & Wilcox Chain Grate Stokers if required.

Stirling type three drum Watertube Boiler, designed for evaporation 40/45,000 lb. hr. on good quality coal. W.P. 200/210 lb.sq.in. Two steam and water drums 20 ft. 6 in. × 4 ft. dia. Twin International Mechanical Stokers motorized 400/3/50, Superheater, Economisers, Soot Blowers, Boiler Feed Pumps, Feed Conveyor, Ash belt Conveyor hot well Tank and pipework.

Two Algerine triple drum Watertube Boilers. W.P. 225 lb.sq.in. Evap. each 15,000 lb. hr. when oil fired with forced draught. Each Boiler tubed as follows: 1,068 tubes, 1 in. diam., 258 tubes 1⅛ in. diam. 128 tubes 1½ in. diam.

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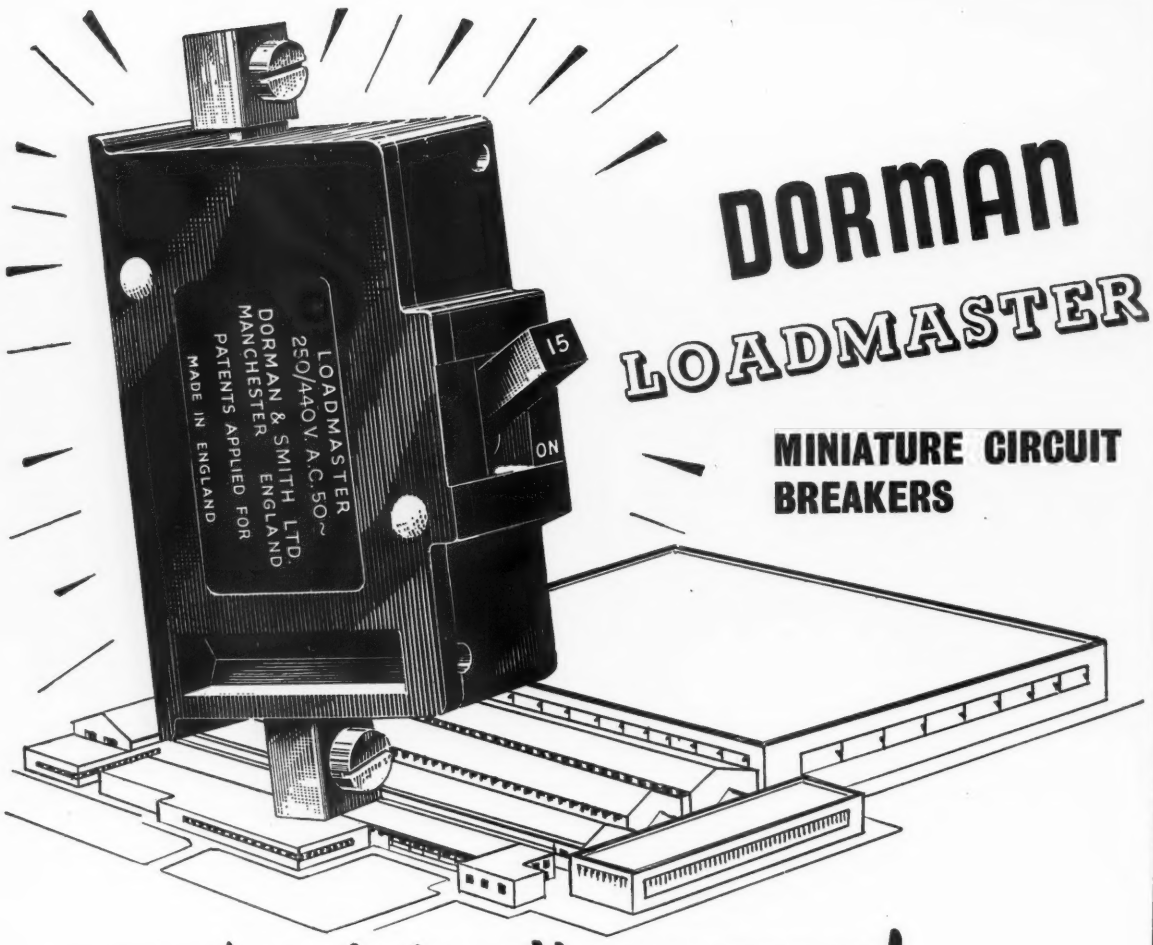

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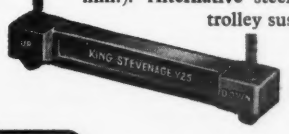

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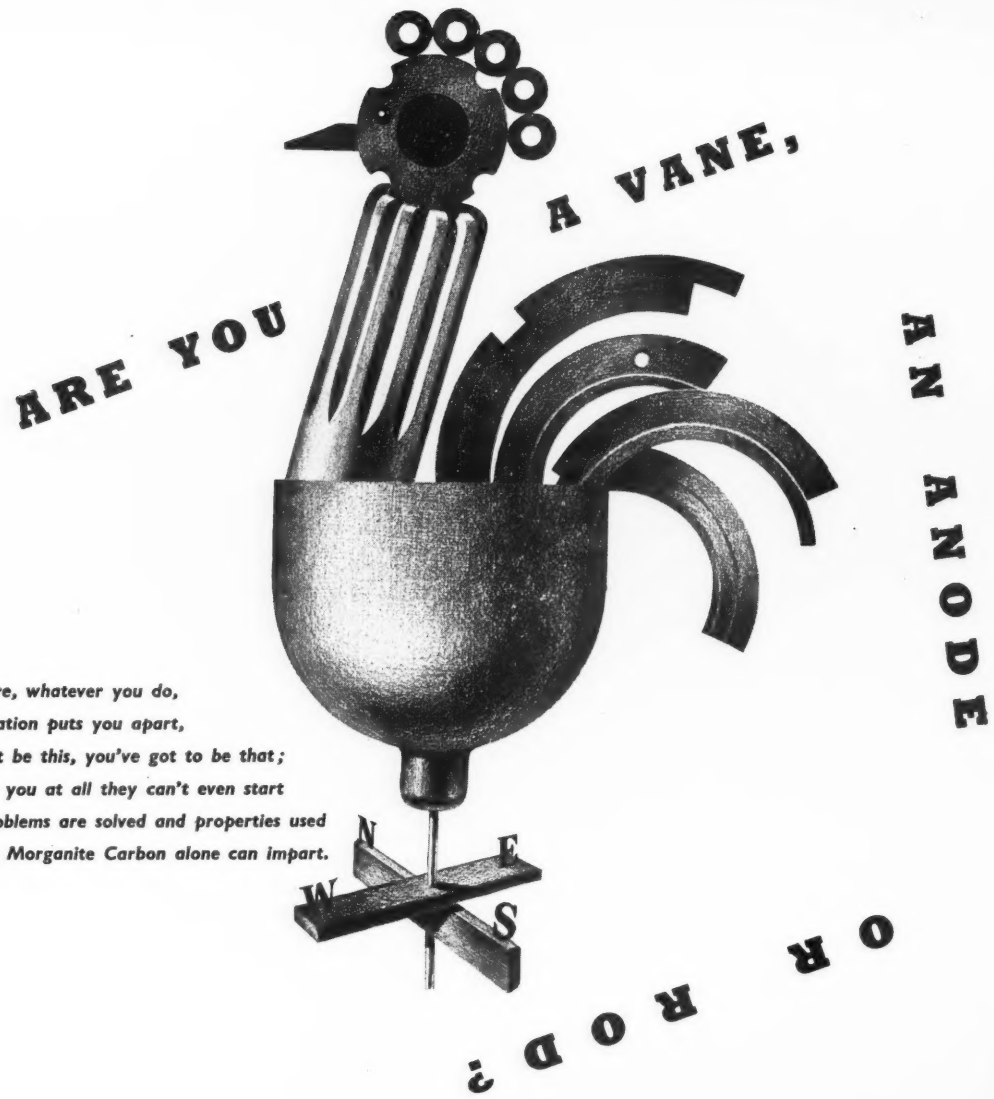

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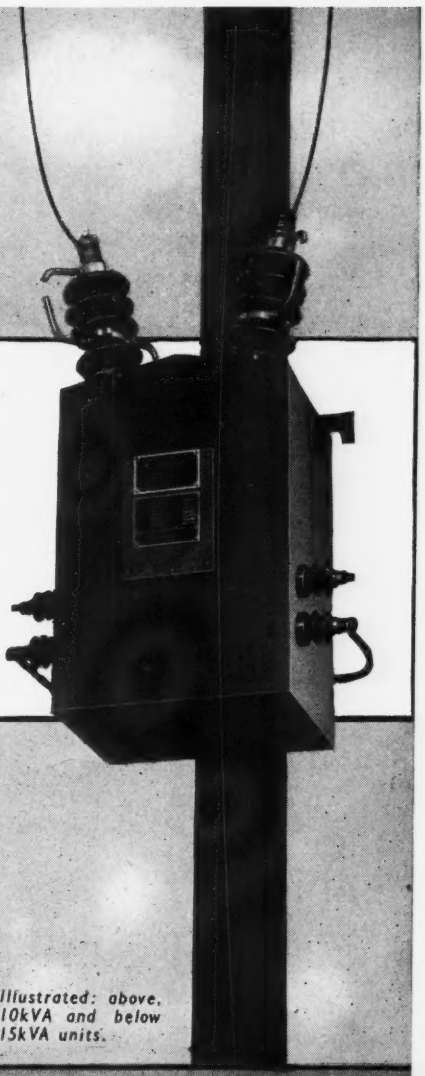

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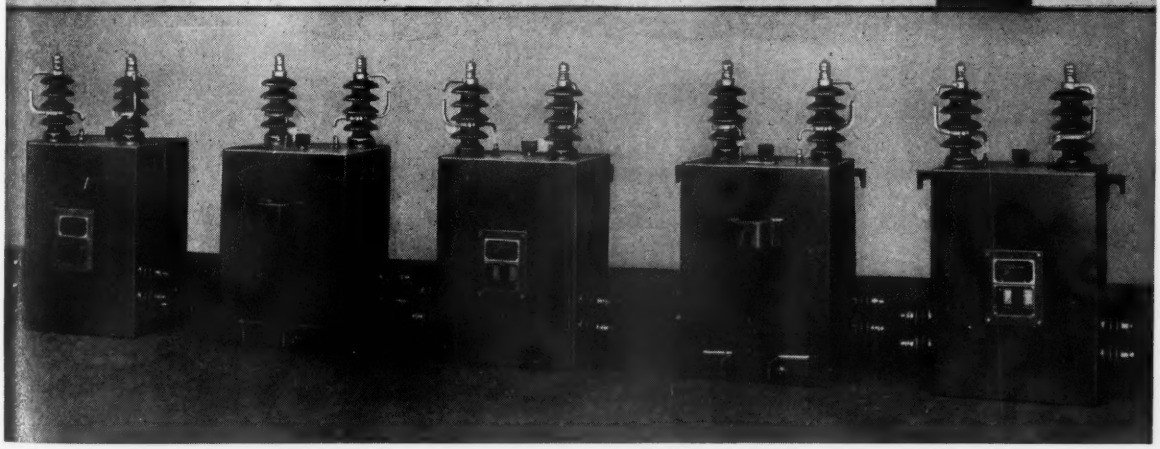

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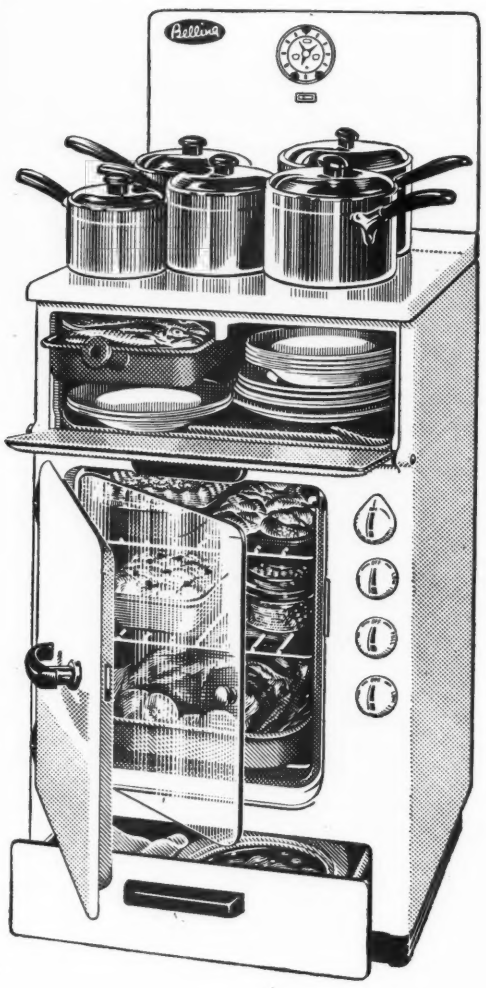

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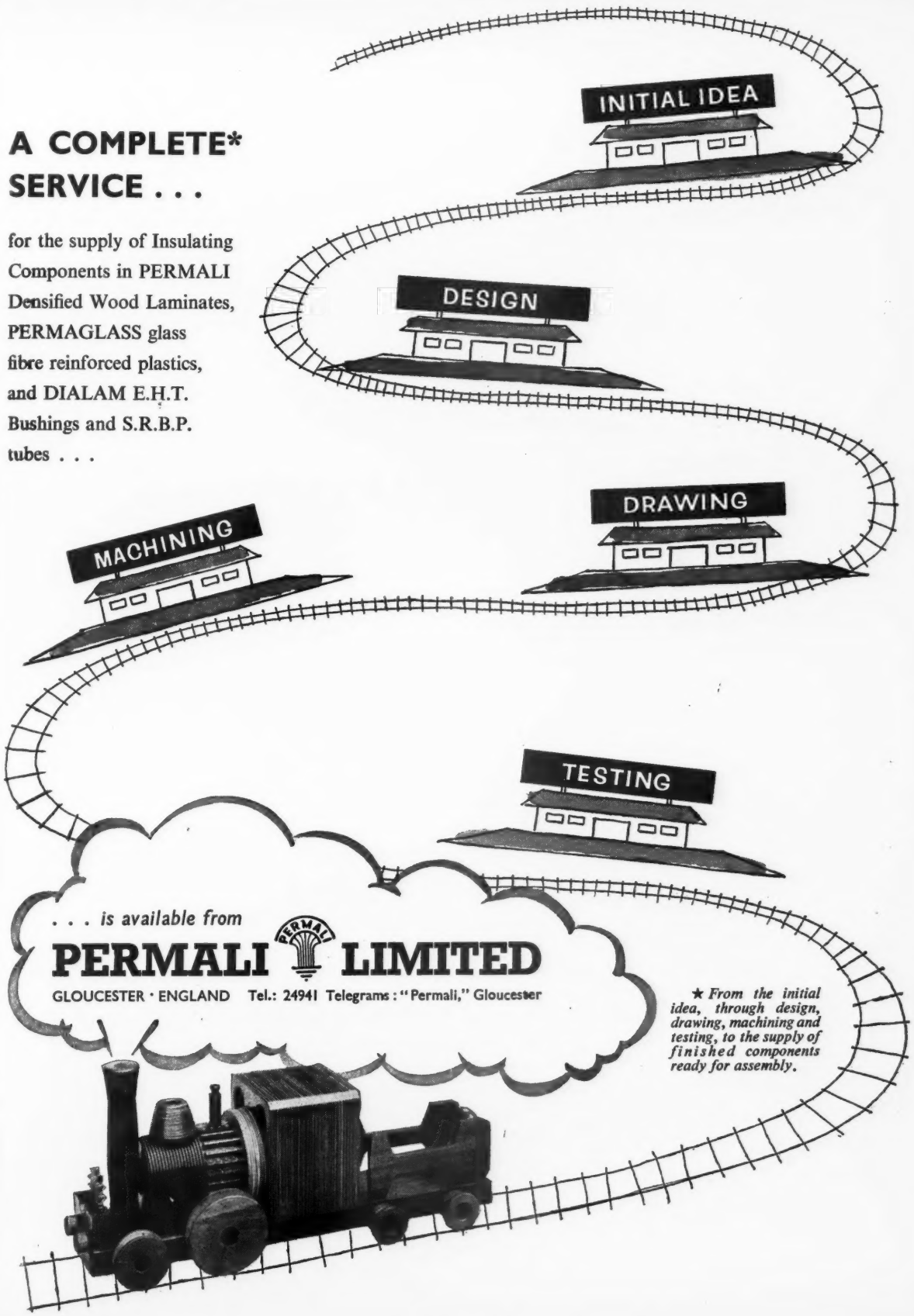

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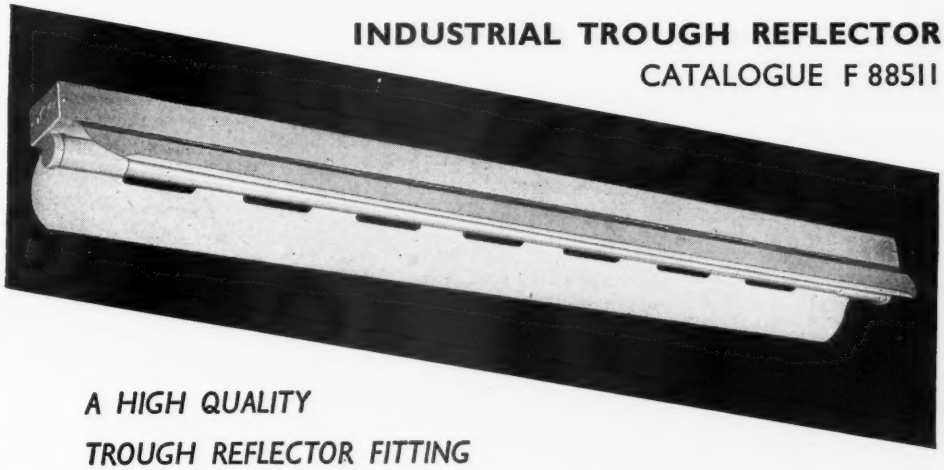

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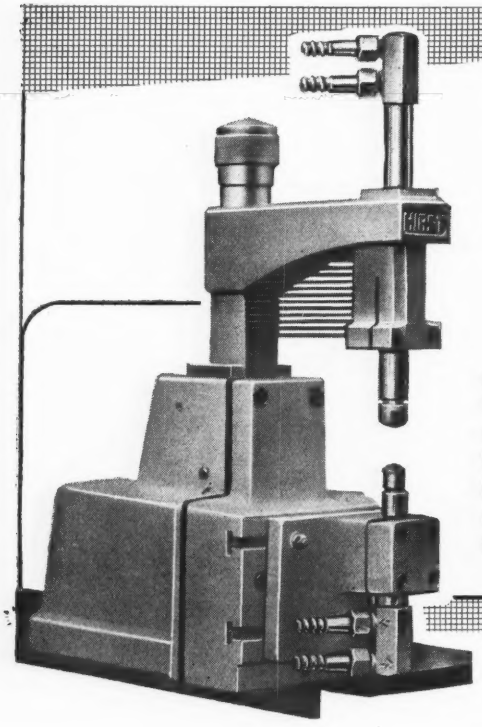

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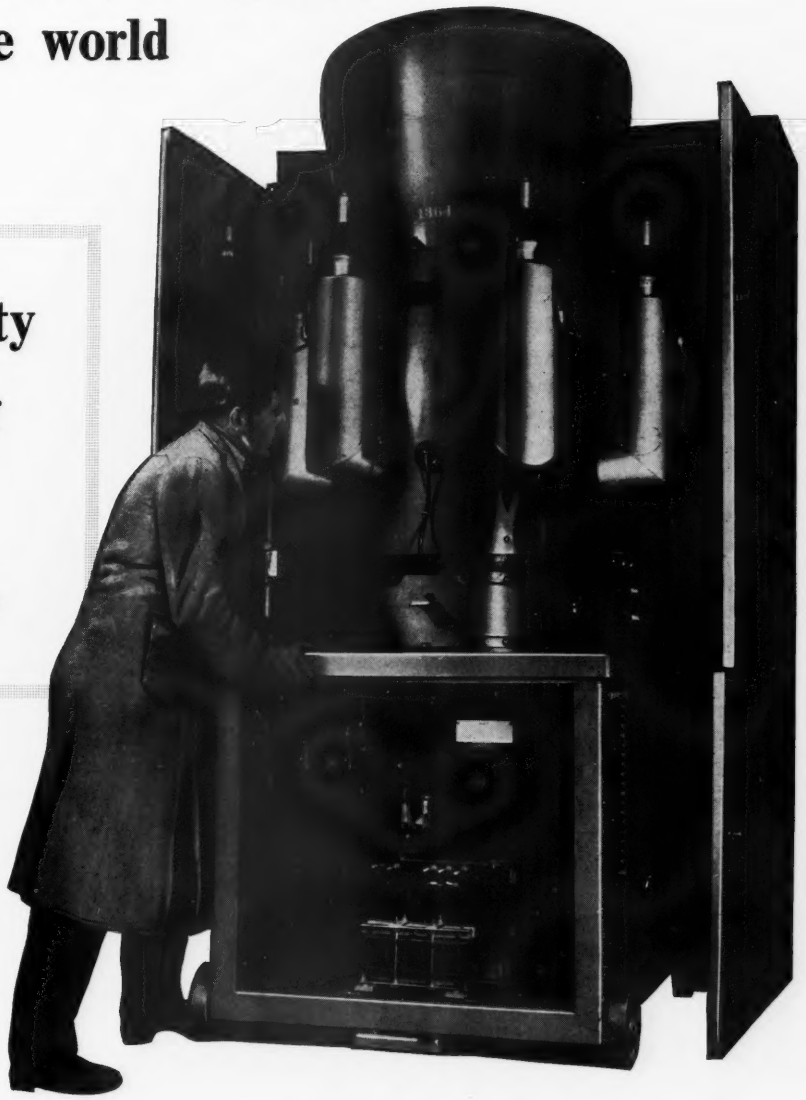

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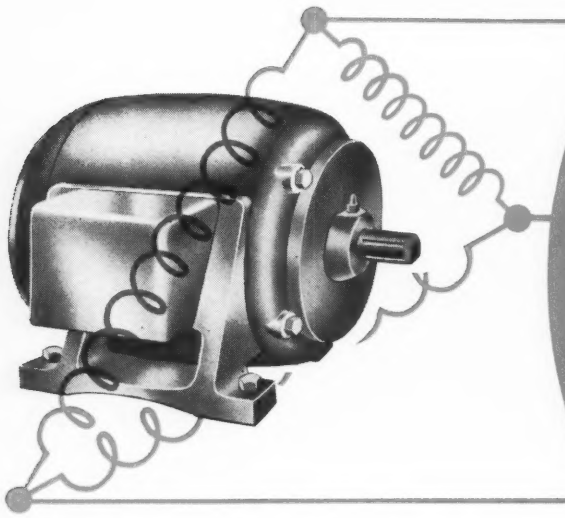

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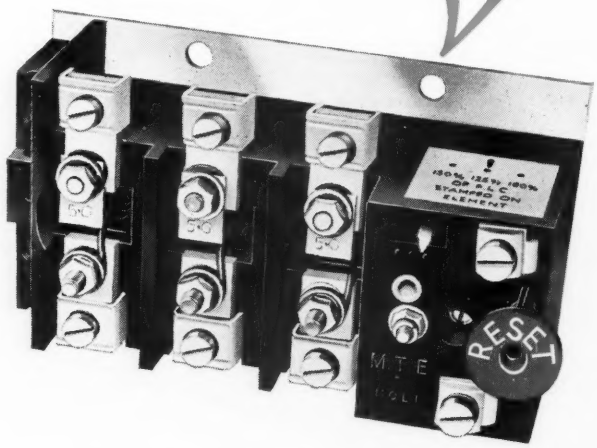

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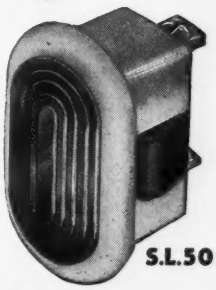
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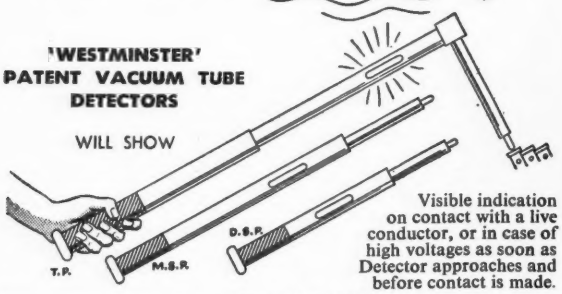

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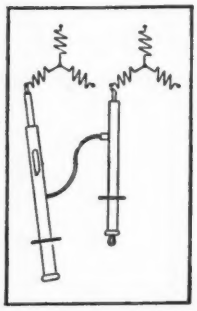

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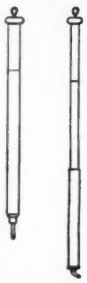

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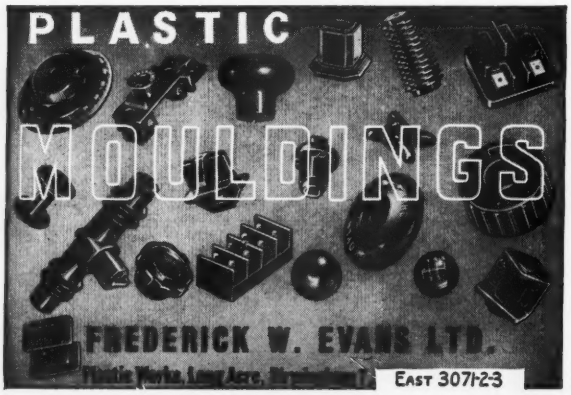

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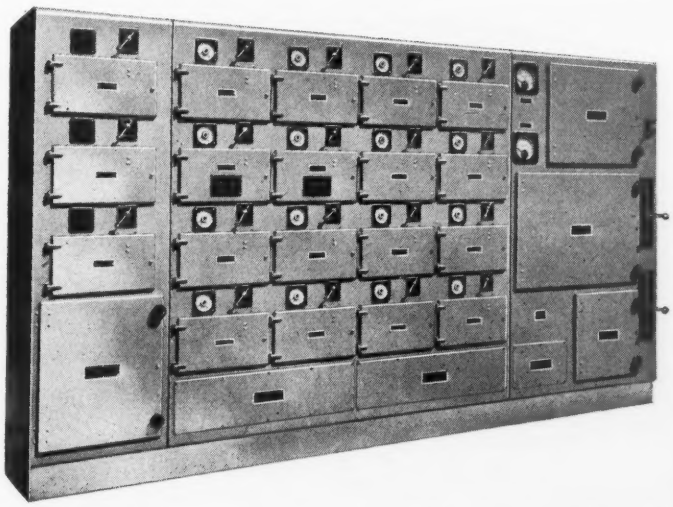

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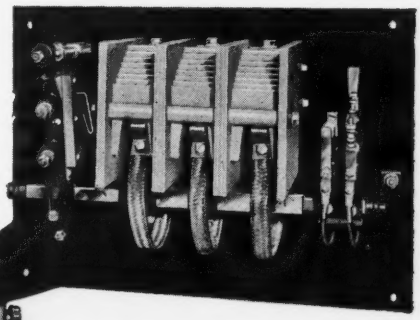

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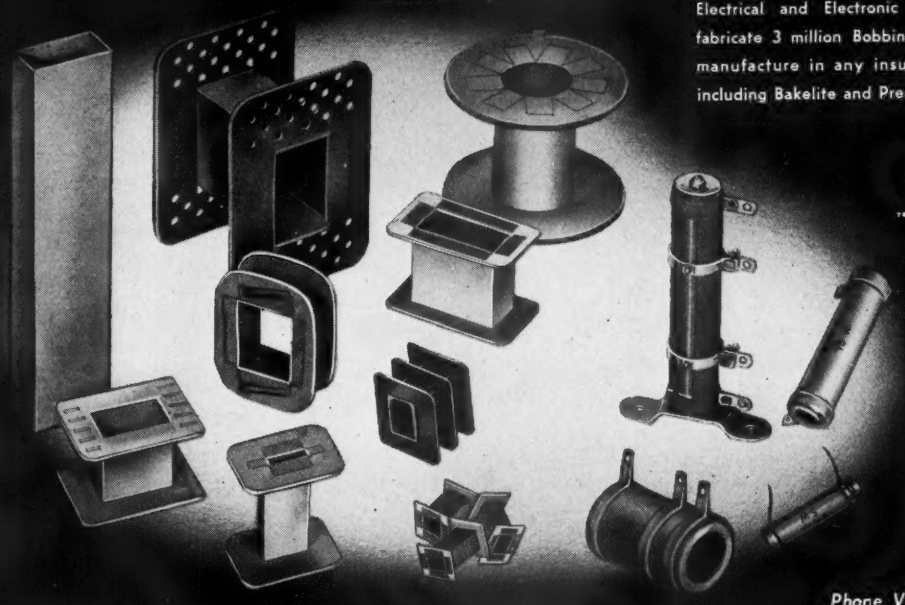

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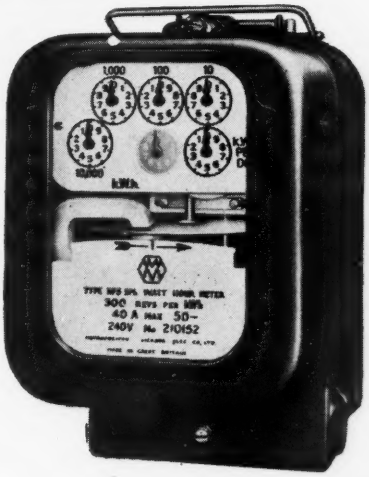

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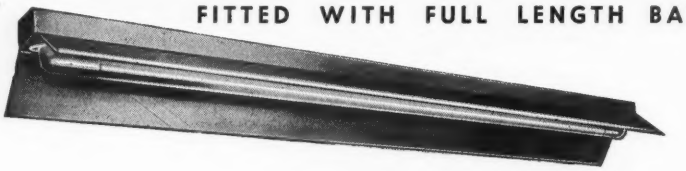

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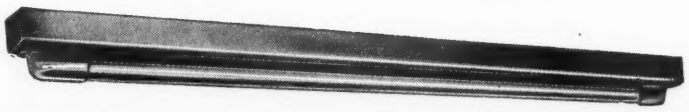

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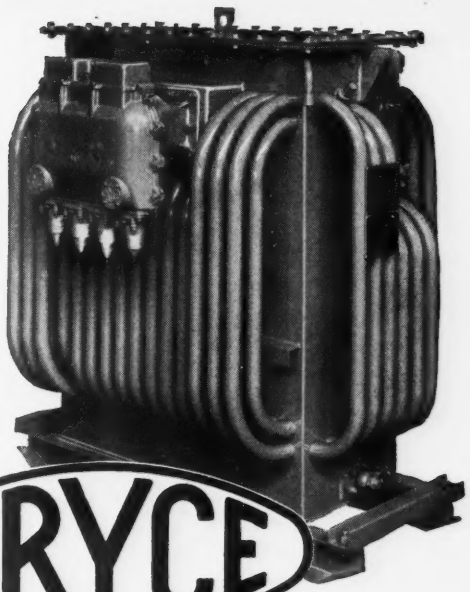

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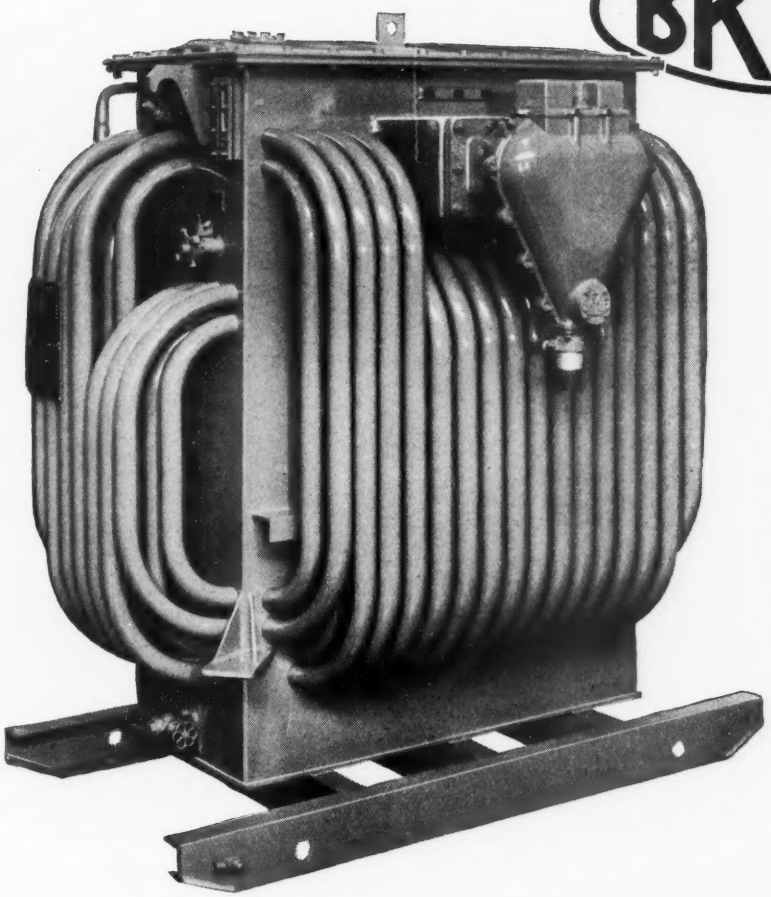

Illustrated are 300 kVA and 500 kVA Transformers having standard losses. Units with appreciably reduced losses can also be supplied.

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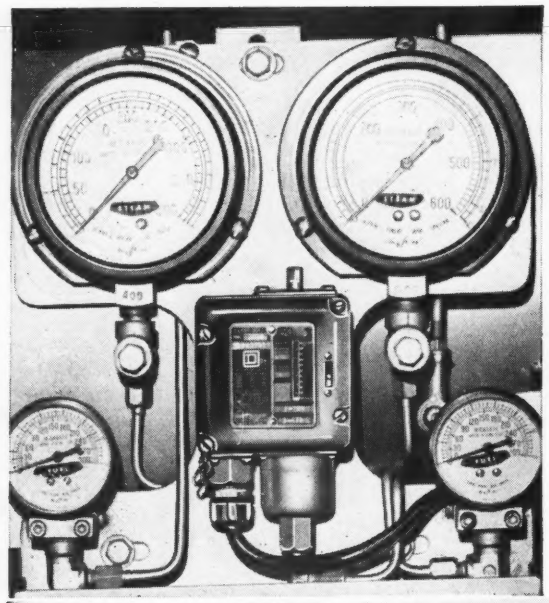

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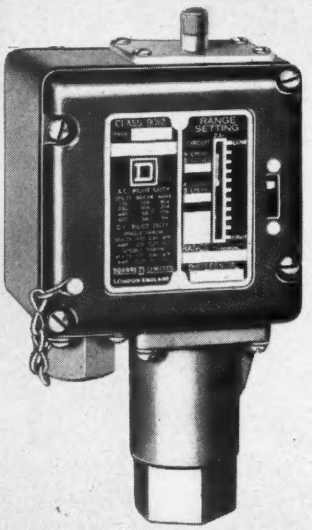

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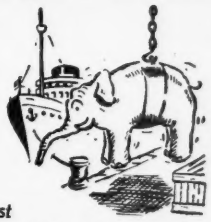

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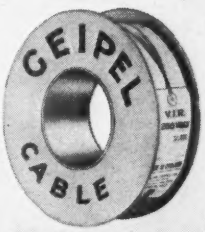

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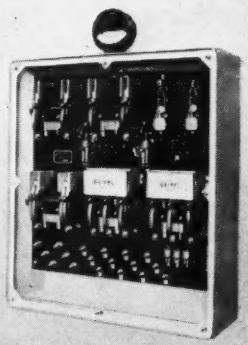

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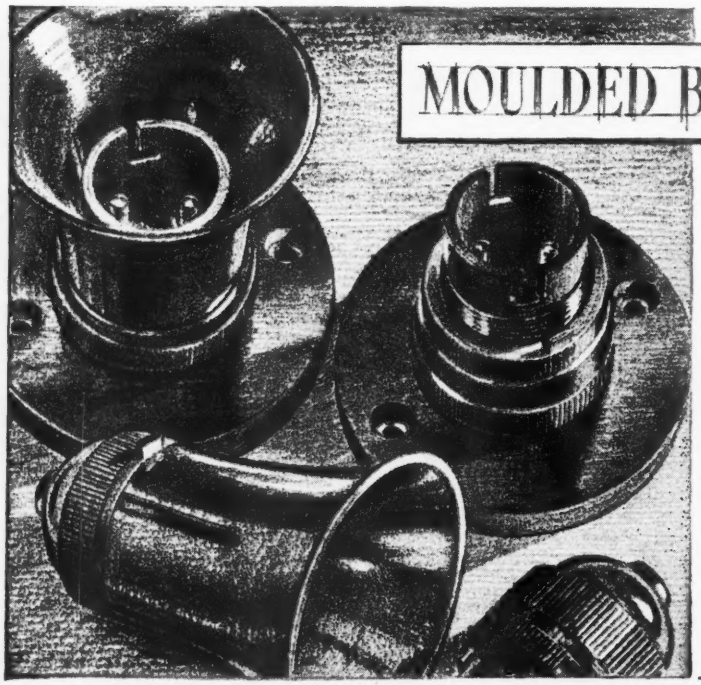

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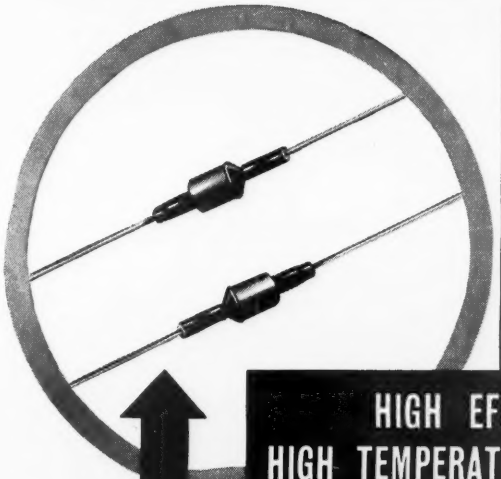

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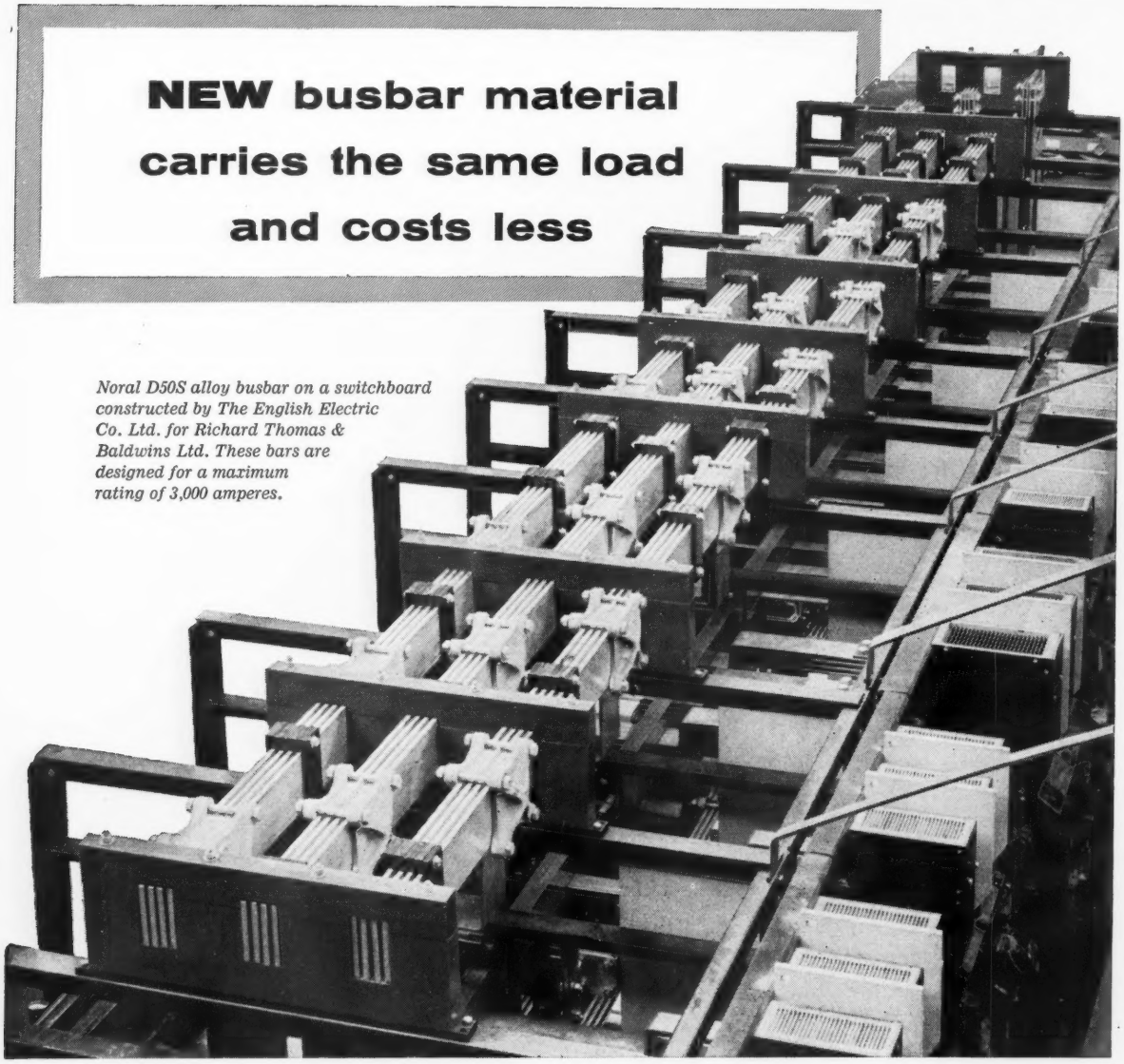

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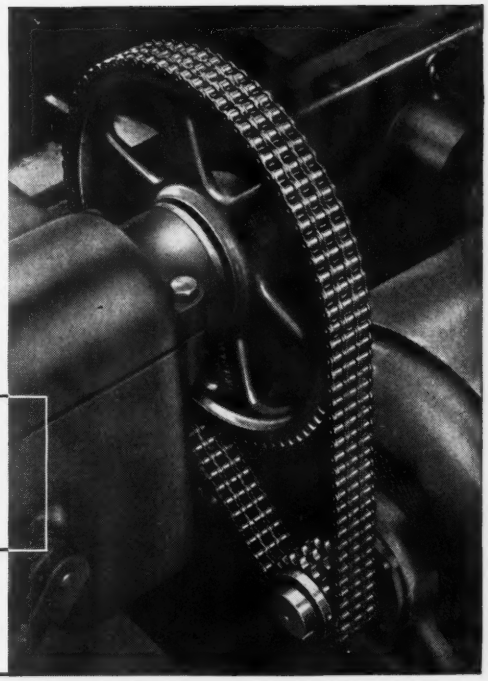

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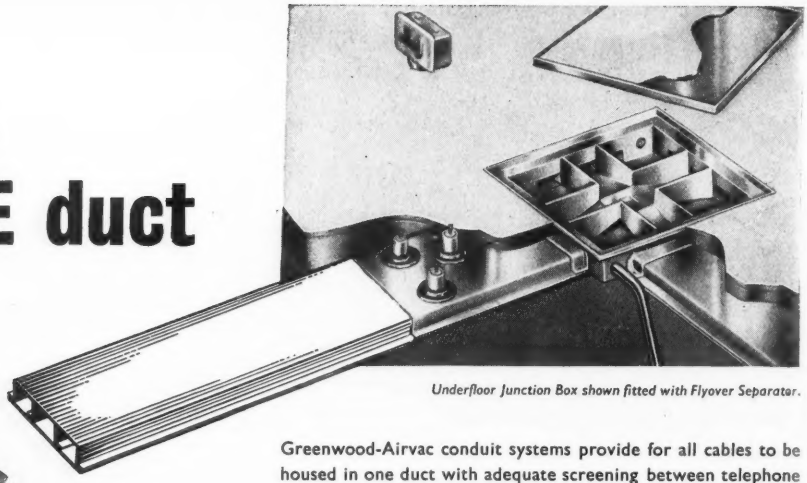

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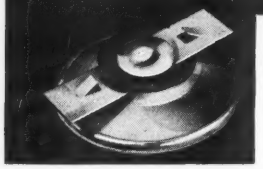

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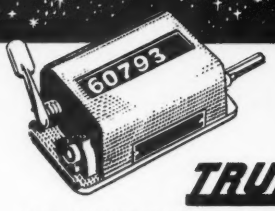

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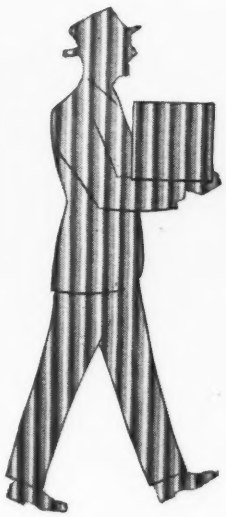

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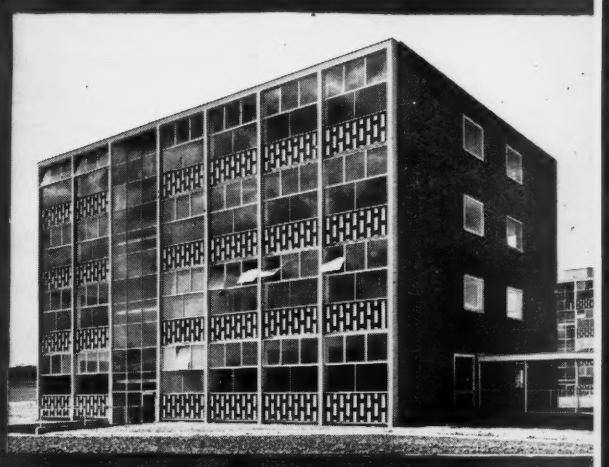

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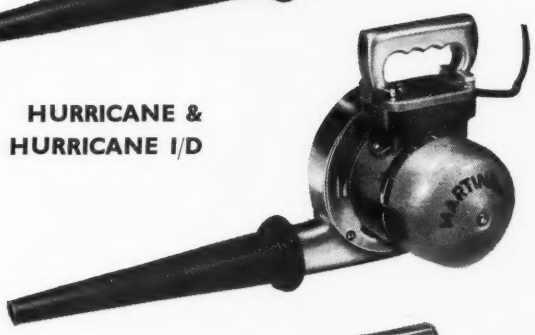

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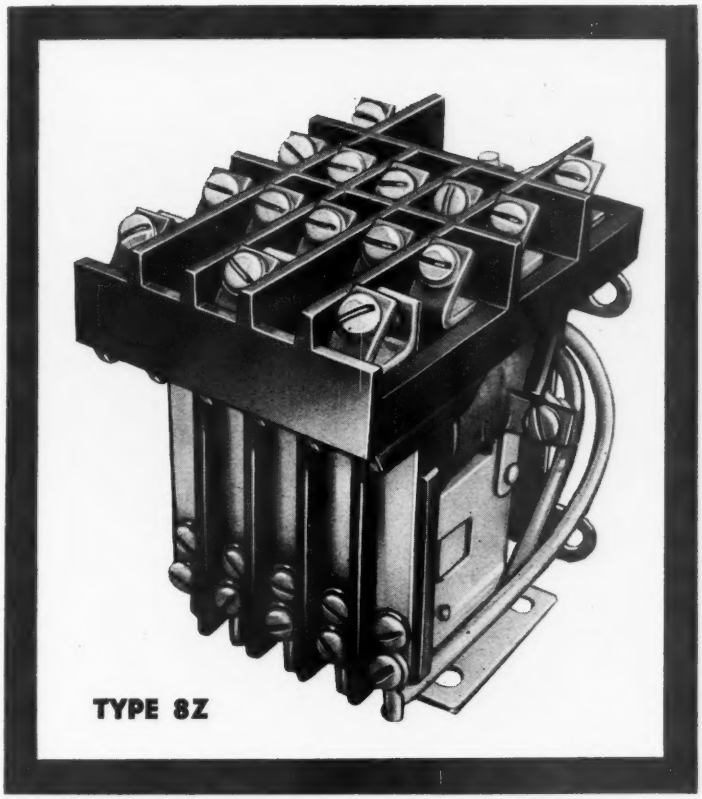

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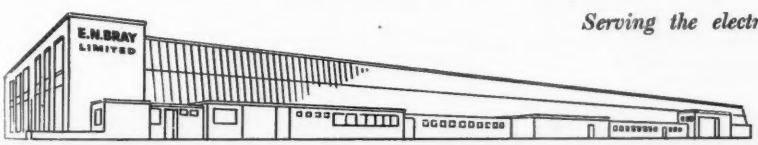

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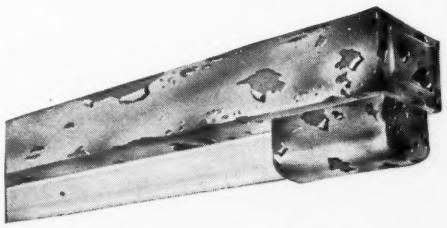
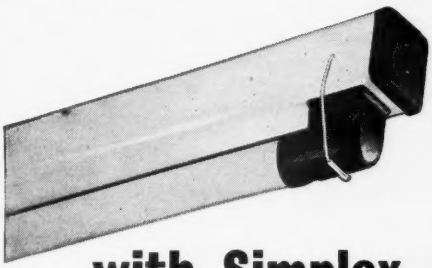


an end to this

Corrosion . . . dampness . . . acid vapours . . . dust-laden atmospheres all are enemies of durability and economy: yet some or all of them are part of every plating shop, laundry, laboratory, dockyard or cotton mill. They are unavoidable on railways, in dye works, on so many places essential to our industry and economy. Corrosion is the enemy of all lighting installations; it costs money



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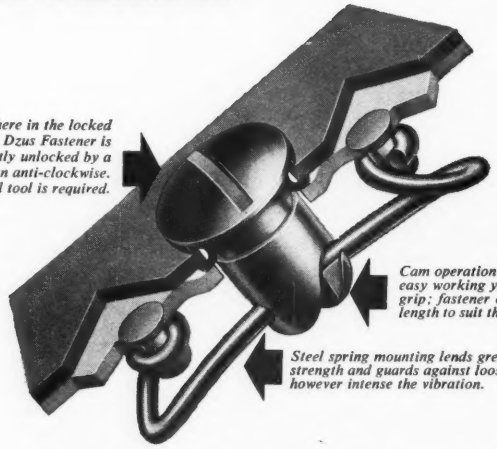

Shown here in the locked position, the Dzus Fastener is instantly unlocked by a quarter turn anti-clockwise. No special tool is required.

Cam operation ensures smooth easy working yet unbreakable grip; fastener can be supplied to length to suit thickness of material.

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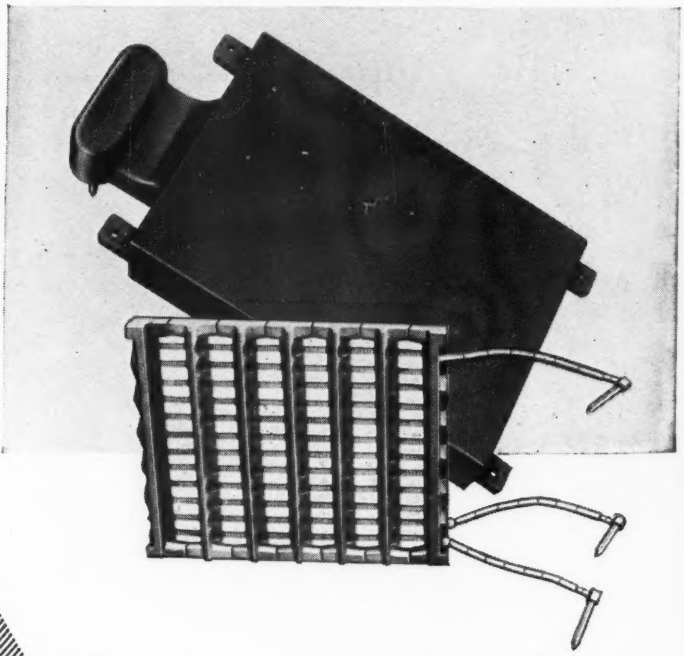

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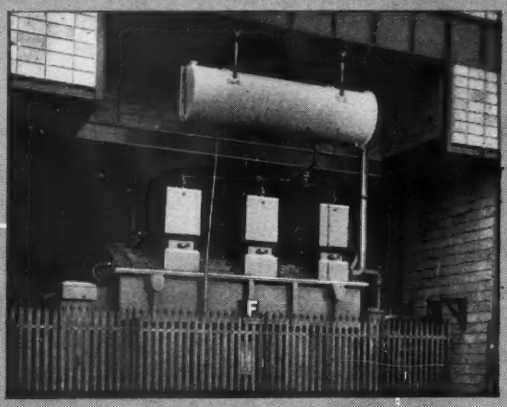

The illustration shows one of the transformers installed at Marchwood Power Station.

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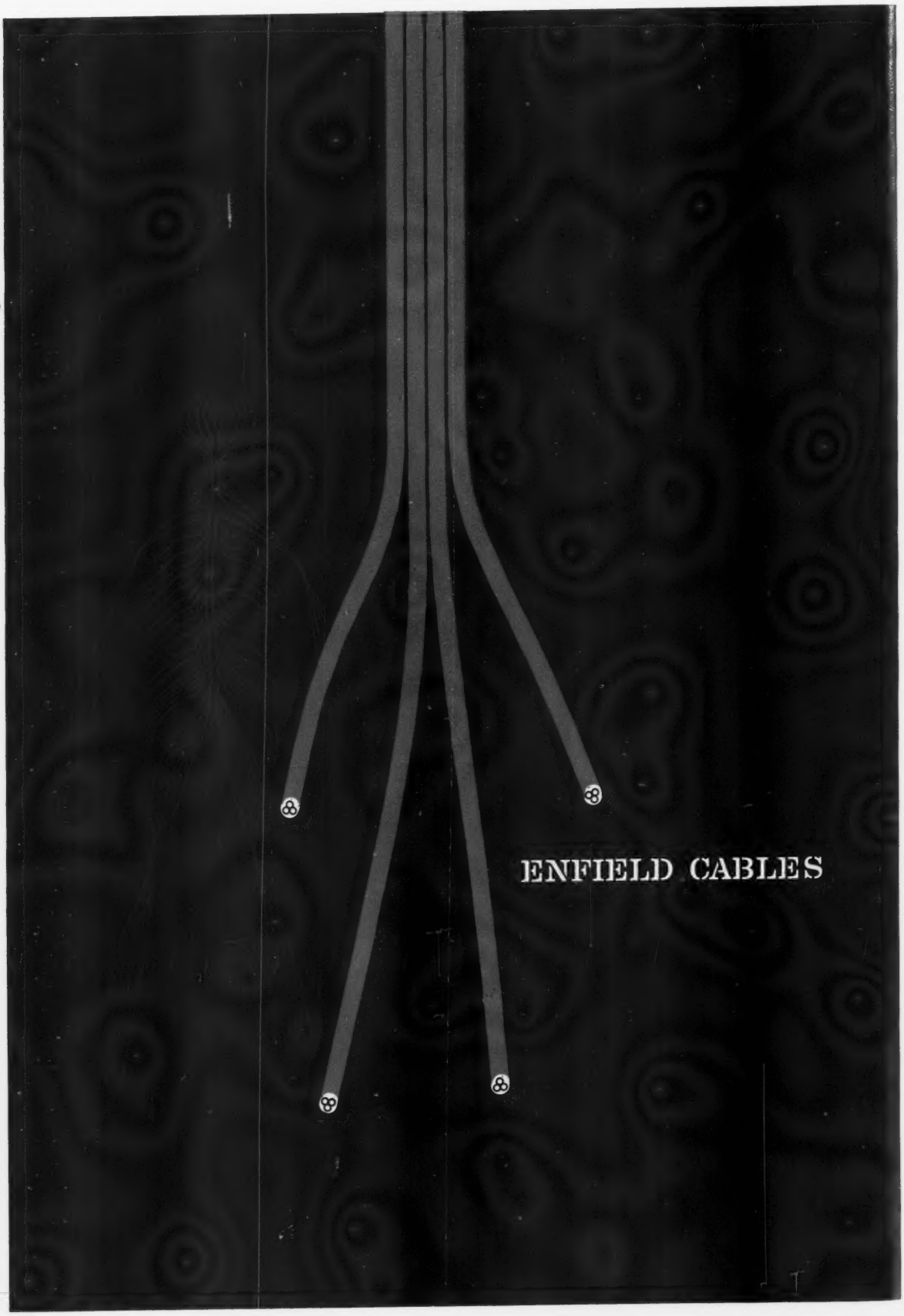
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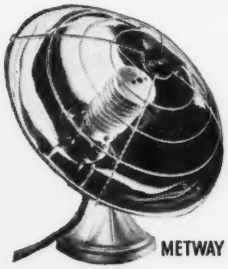

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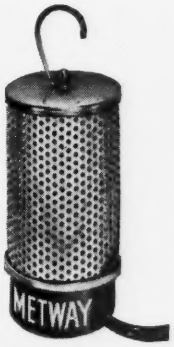

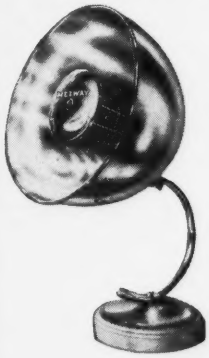

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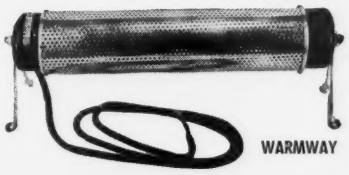

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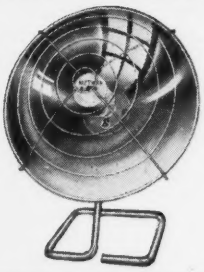

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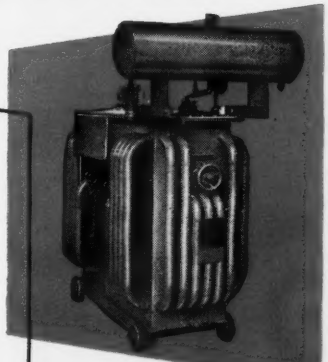

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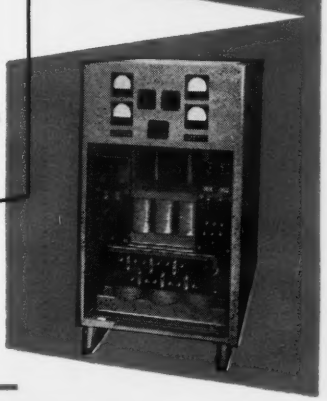

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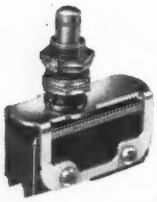
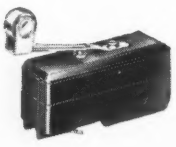
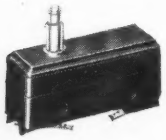


Catalogue Listing BA-2R pin plunger switch assembled with bracket actuator MCA2711. This assembly permits panel mounting and additional overtravel. Switch can be easily removed without altering plunger position.

Catalogue Listing BA-2RL2. This switch, roller leaf actuated, can be used with fast slides or cams. Small force—relatively large operation movement.





Catalogue Listing BZ-2RS is an overtravel plunger switch. Operating characteristics are closely held but the plunger permits some overtravel. Operating force—only 9-13 oz.

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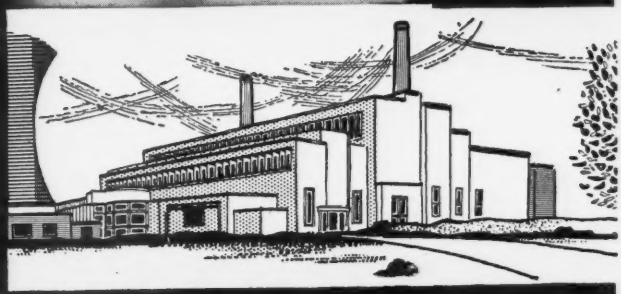

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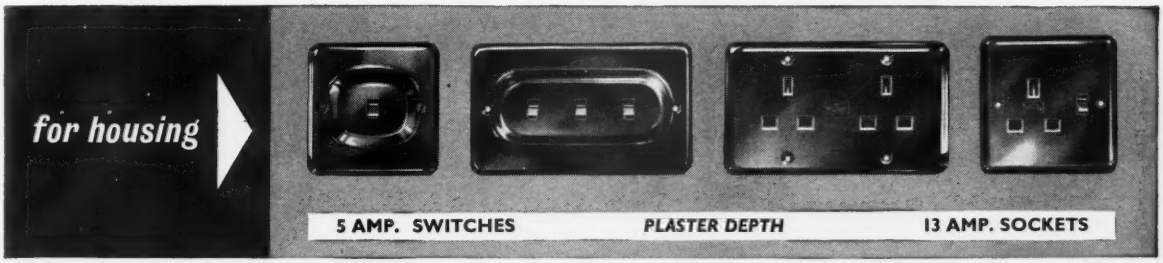

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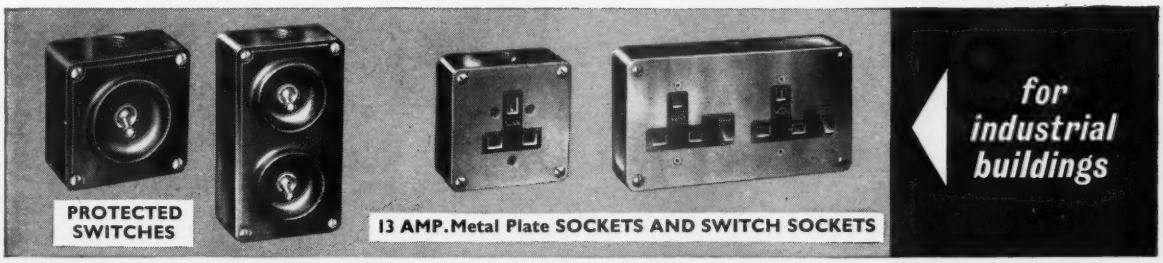

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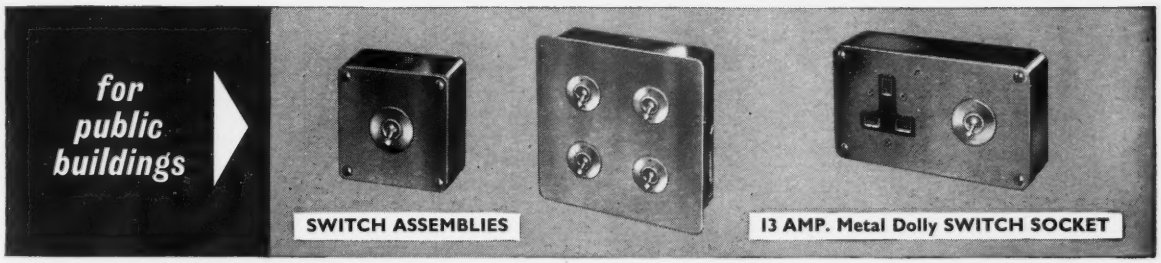

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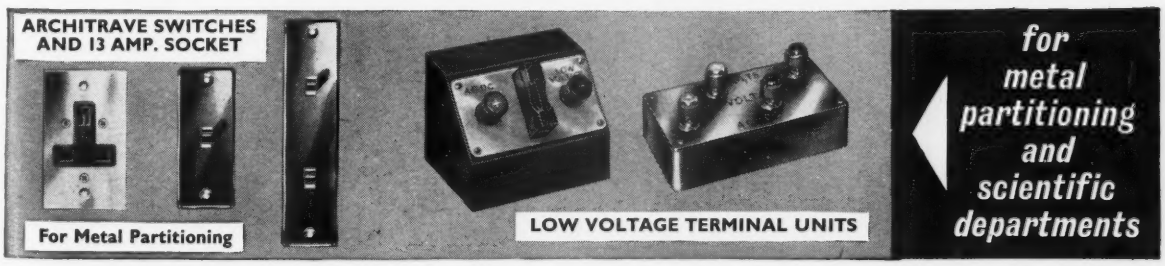
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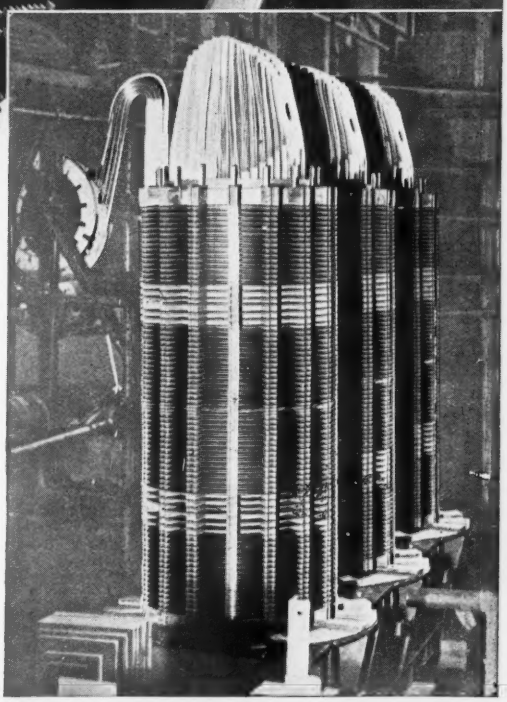

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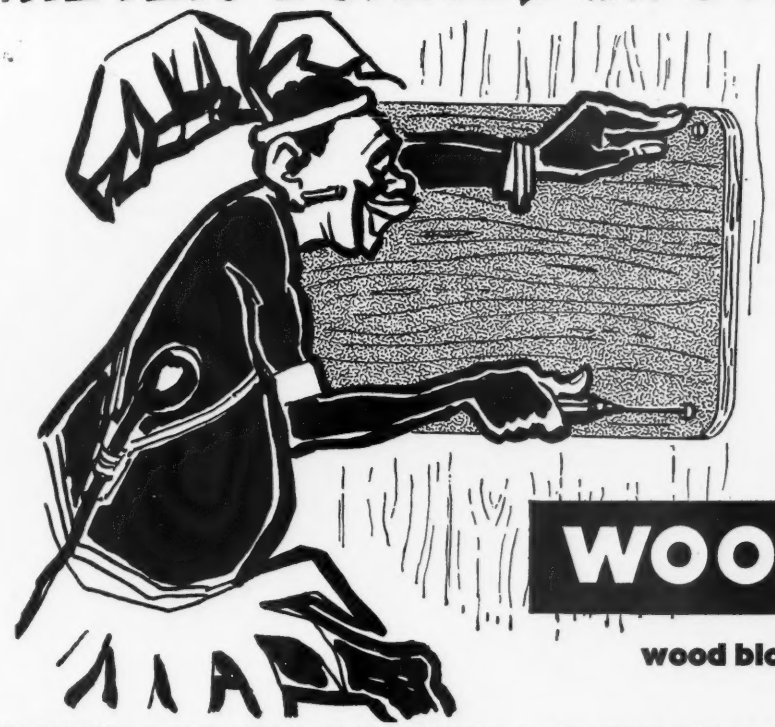

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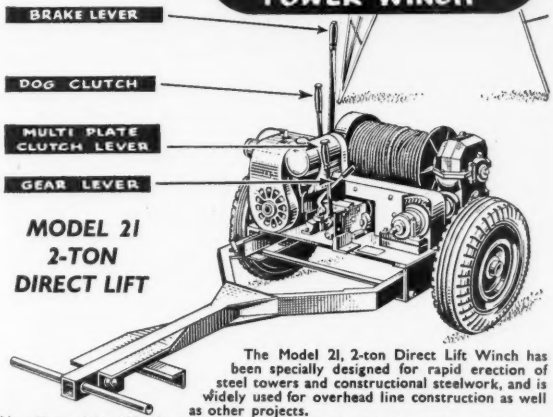

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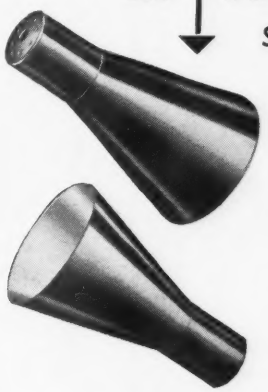

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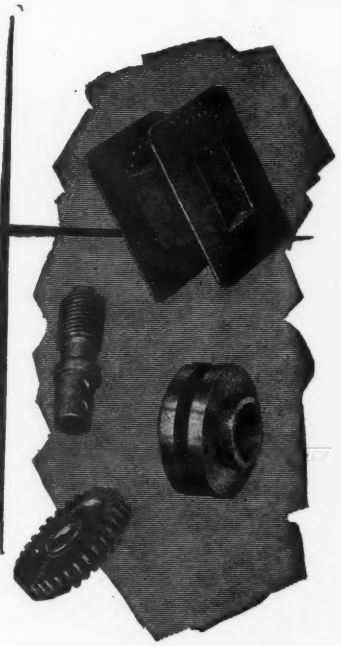

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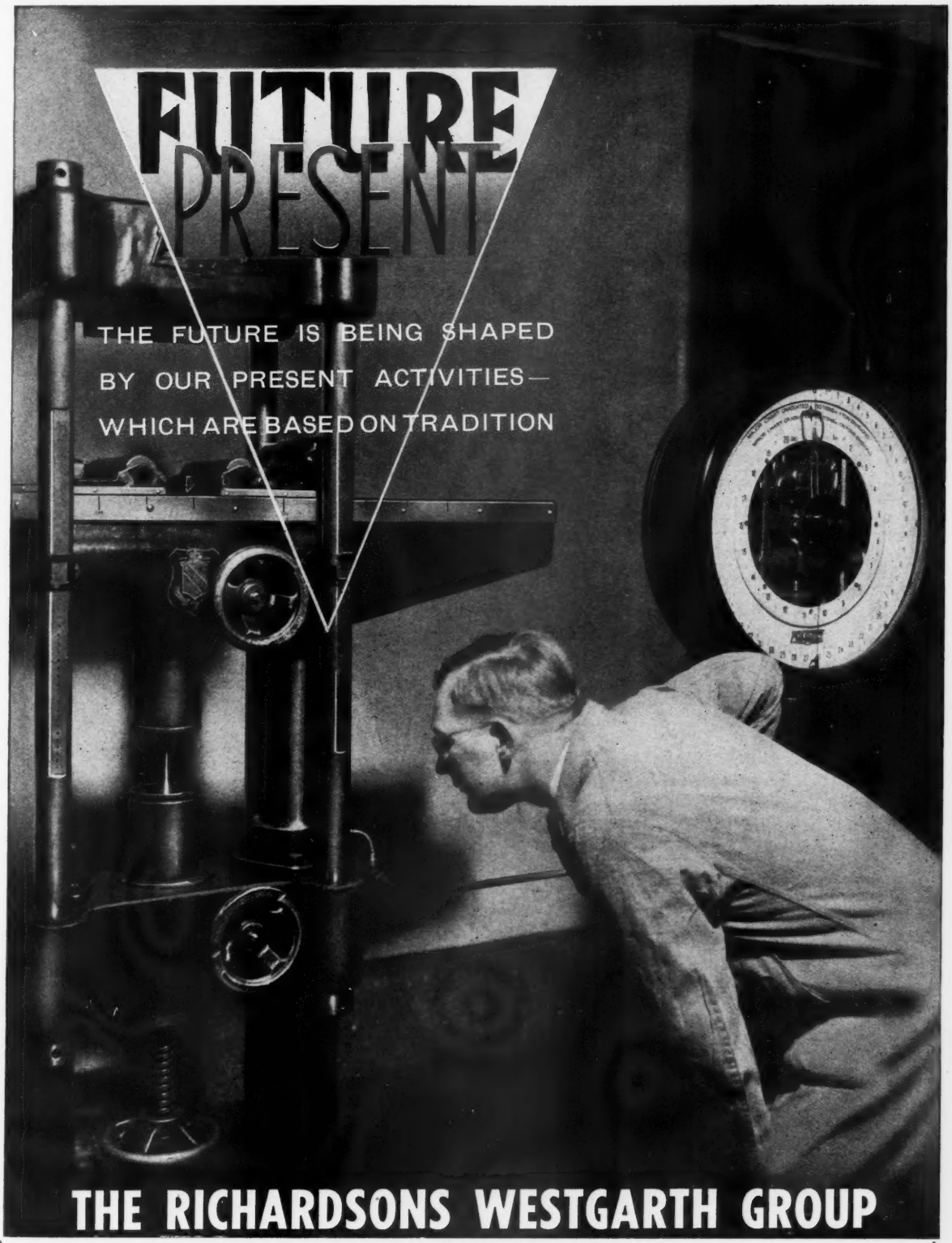

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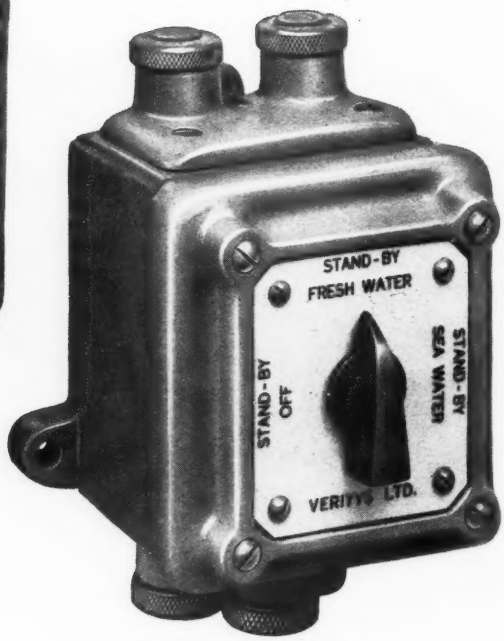

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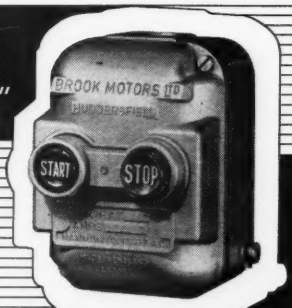

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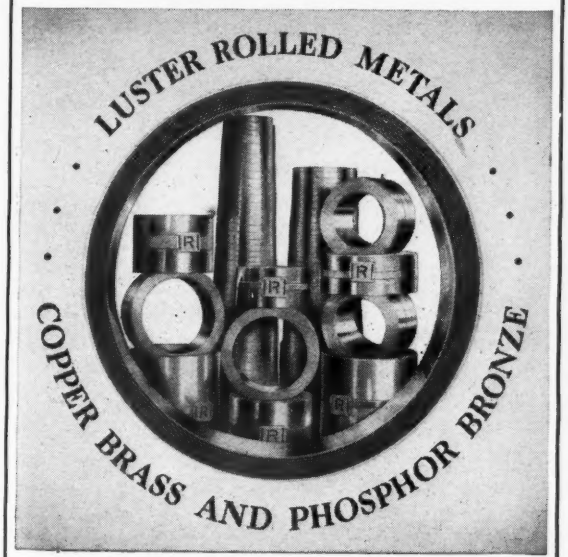

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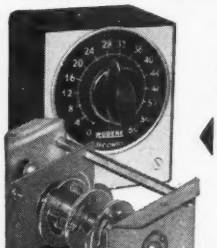

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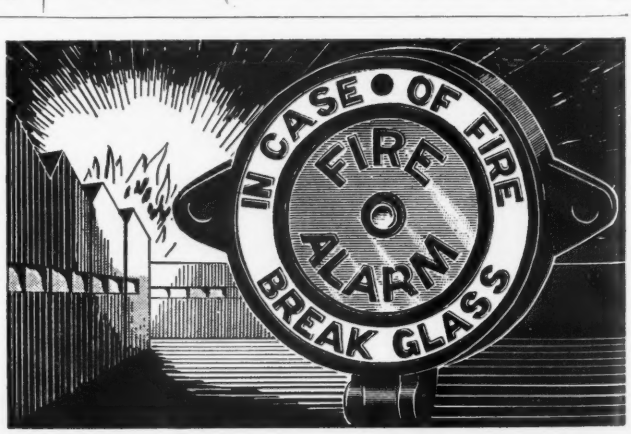

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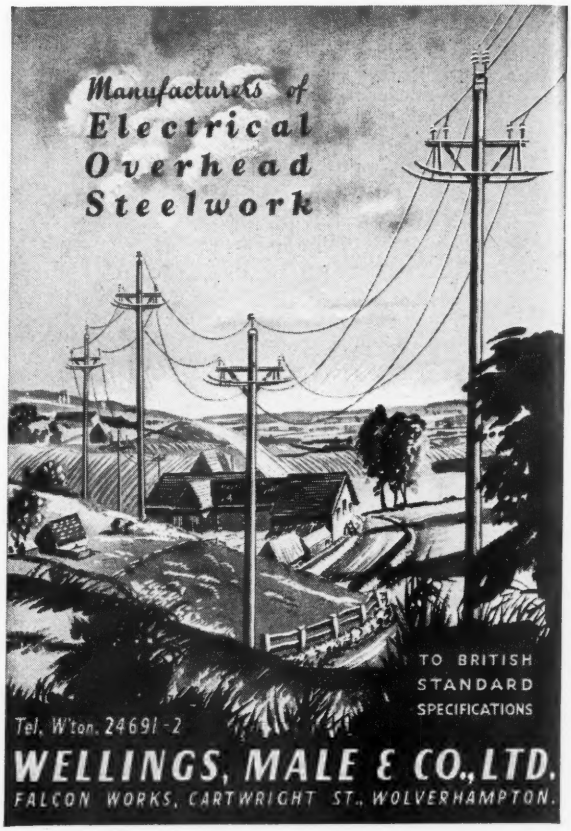

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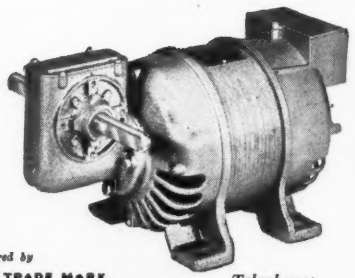

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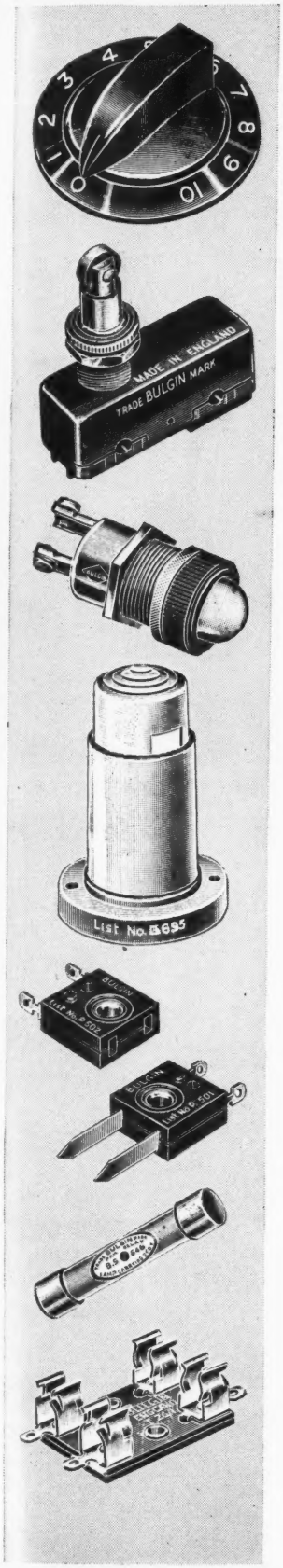

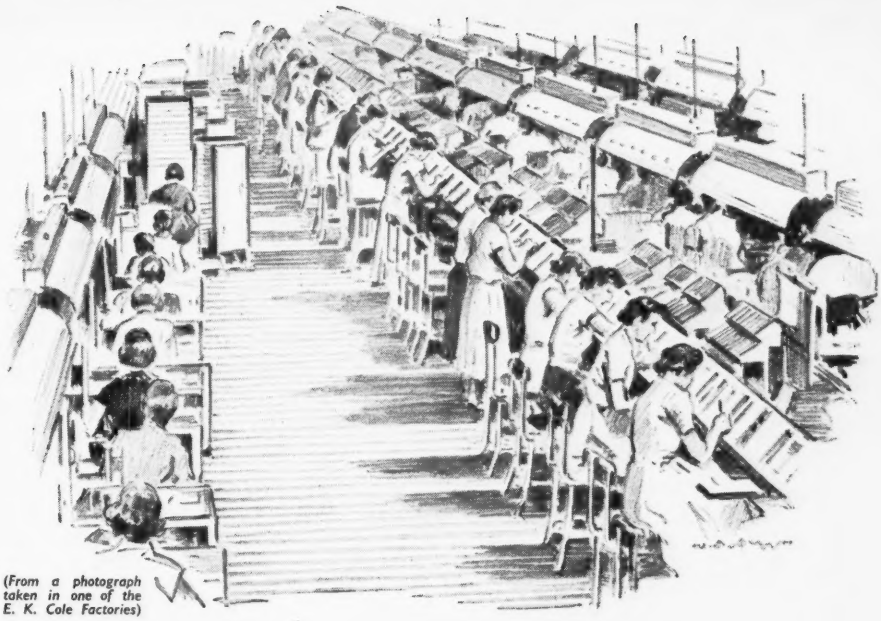

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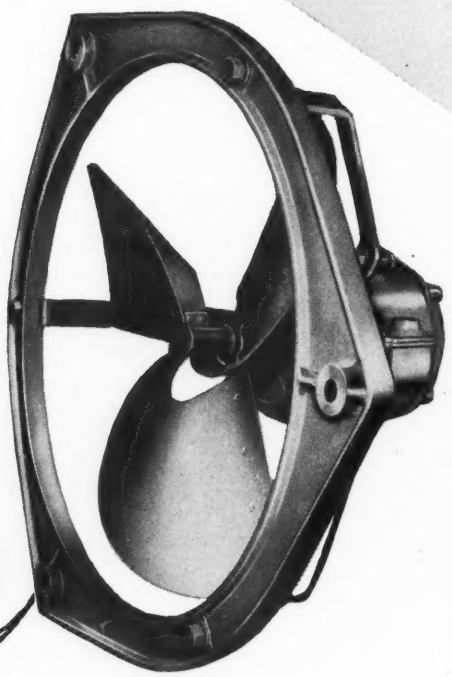

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23 AUGUST
1957

ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E. *General Editor:* J. H. COSENS *Technical Editor:* P. W. TUCKER, M.I.E.E.

In This Issue

Electrode or Open Hearth?	307	The use of arc furnaces for the production of plain carbon steels is discussed
The Microtron	309	An alternative type of electron accelerator
Low-Carbon Steel Production	313	Implications of the Battelle Report
Domestic Electricity Survey	321	Analysis of consumption for specific uses
Goldington Power Station	331	In this station, officially inaugurated last week by the Lord Lieutenant of Bedfordshire, five of the six 30 MW sets planned are now in operation
Cable Ratings	335	Rapid method of calculating cyclic rating factors
Nuclear Power Station for Wales	343	Application is to be made by the C.E.A. for consent to erect a 400-500 MW station at Trawsfynydd, Merionethshire

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Yugoslavia as a Market	317	**New Electrical Equipment**	339
Views on the News	319	**French Imports and Exports**	341
Letters to the Editor	320	**Generation and Development**	344
Personal and Social	323	**Financial Section**	346
Industrial News	325	**New Patents**	349
Continuous Stress Relief of Laminations	328	**Contract Information**	350
Electrical Research Reports	329		
French Railway Electrification	330	*CLASSIFIED ADVERTISEMENTS*	103
News from South Africa	334	*INDEX TO ADVERTISERS*	116

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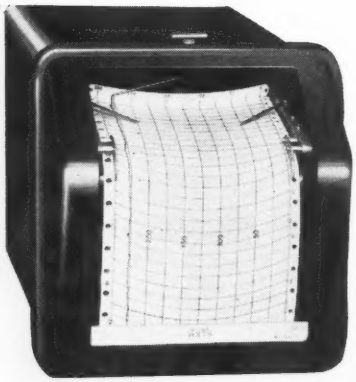

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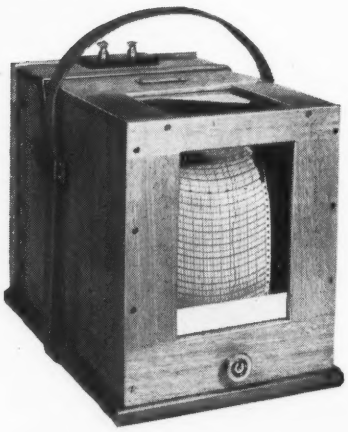

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ELECTRICAL REVIEW

23 August 1957 Vol. 161 No. 8 Established 1872

Electrode or Open Hearth?

FOR many years we had been under the impression that the electrode arc furnace was suitable and economical only for the production of the higher grades of steel. Then came a few years ago the Battelle Report with the suggestion that American practice had shown that there was a case for the production of ordinary mild steel by means of the arc furnace. The introductory words of the report were:—" Within the last few years improvements in furnace design and operation have materially lowered electric furnace steel making costs to the point where use of this process in the production of plain carbon steels appears to be almost competitive with the open hearth."

In his article " Low Carbon Steel Production " which we publish on page 313 of this issue, Mr. R. W. Evans says that the Battelle Report has highlighted those aspects of cost and operation which would affect a decision to use either the electric furnace or the open hearth process and the *Electrical Review* has enabled maximum benefit to be derived from the report by publishing articles giving the views of various sections of industry. Mr. Evans writes from the steelmaker's standpoint, and electrically his article is not nearly so optimistic as those of Mr. R. L. Gaunt (electricity supply) in the *Electrical Review* of 14th May, 1954, and Mr. J. C. Howard (electric furnace manufacturing), *Electrical Review*, 18th June, 1954.

It is claimed that the steelmaker had very little hand in preparing the report despite the fact that he would have had the greatest interest in its findings; also that there has been no significant expansion of electric furnace steel production in America. We feel, then, that the place of the electric furnace in this country may be different from its situation in the United States for, apart from considerations of steel quality, the relative prices of scrap and pig iron affect the economy.

Mr. Evans seems to feel that the report has not dealt adequately with the question of steel quality, as he claims that the open hearth furnace is a better oxidising medium than the electric furnace because its higher melting temperatures depend upon an excess of air being present, while in the arc furnace there is no excess of air, so that those steels requiring a high oxygen content for their production are not so easily produced in the electric furnace.

Be this as it may, our only object in obtaining these varied views was to try to arrive at the basic facts out of some rather conflicting statements. We may not have been completely successful in obtaining definite conclusions, but we feel that the articles have done a great deal to clear the air.

NUCLEAR POWER IN WALES

The anticipated statement by the Central Electricity Authority of its intention to site its fourth nuclear power station in North Wales was made last week. The proposal is to erect a 400-500 MW plant at Trawsfynydd, Merionethshire, which will be connected by an overhead line to the 275 kV transmission system at the Ffestiniog pumped storage station which is now being constructed about five miles distant. Cooling water is conveniently to hand in the shape of the 30-year-old Trawsfynydd reservoir provided for the Maentwrog hydro-electric scheme.

Looking further ahead, the C.E.A. has picked a site for another North Wales nuclear power station—at Edern, Caernarvonshire. As this station will be on the coast unlimited supplies of cooling water will be available and, as in the case of Trawsfynydd, the reactors will be built on solid rock.

These stations will be welcomed by the people in the North Wales area who, through their local authorities, have been pressing the C.E.A. to erect a station in the area. Already there are signs of opposition to the schemes although, no doubt, most of the objections by the amenity societies will merely aim at securing that the stations will be as unobtrusive and as handsome as possible.

NEW EXPERIMENTAL REACTOR

An announcement has just been made by the United Kingdom Atomic Energy Authority that it is intended to build a zero energy assembly for an entirely new type of gas-cooled nuclear reactor at the Authority's proposed new research station at Winfrith Heath. The contract for a large part of the design and construction of this equipment has been awarded to the General Electric Co., Ltd. This zero energy assembly is the first stage in the development of a reactor system in which fuel temperatures will be raised well above those possible in present designs. The resultant higher gas temperature would then enable electricity to be produced more efficiently by conventional steam turbo-generator plant or possibly by gas turbines.

The experimental assembly will be used primarily to examine the nuclear properties of the system and to verify design calculations before proceeding to a power reactor. It is so designed that the nuclear reactions will take place at a very low rate and very little external radiation or heat will be produced. Hence the term "zero energy." If the experiments are successful the gas-cooled reactor and its associated heat exchanger system is likely to provide steam at pressures and temperatures equal to those at present attained in the more advanced fuel-fired boilers.

EXTRAVAGANT CLAIMS

At a time when a growing number of concerns are reporting reduced profits, the Confederation of Shipbuilding and Engineering Unions has confirmed its threat to call for a reduction of the working week from 44 to 40 hours, as well as demanding an extra week's holiday with pay, two further "statutory" days' holiday and holiday pay based on earnings instead of the basic rates. The cost of conceding these claims is put at well over £200 million a year; the increase negotiated in May last is already expected to add about £140 million to costs in a full year.

During the discussion of the resolutions at last week's annual general meeting of the Confederation Mr. W. Carron, president of the Amalgamated Engineering Union, claimed that shorter hours would stimulate efficiency in the engineering industries by forcing the employers to modernise their factories in order to produce the same amount in a shorter time. It has been suspected that the unions' demand for a shorter working week was merely a subterfuge for securing four extra hours at overtime rates, but one delegate warned the meeting of the danger of this idea which, he said, would make a mockery of the demand.

ELECTRICITY IN THE HOME

In 1955 the Utilisation Research Committee of the Central Electricity Authority and Area Boards carried out a survey of domestic electricity consumers. On the basis of visits to one in every thousand consumers, a first report was published last year which gave the estimated appliance saturation factors and other useful data. This has now been followed by an interim report which analyses the annual electricity consumption of householders possessing particular electrical appliances, e.g., cookers, water heaters and space heating equipment.

From this a number of interesting points emerge, such as that generally consumption is greater in the south than in the north. In the case of space heating, the average in the south at the time of the survey was 760 kWh while in the north it was only 460 kWh; from this it would appear that in the north electricity is used to a greater extent for supplementary heating only. It is also seen that utilisation rises sharply with installed load (up to 1 kW, 125 kWh per annum; over 5 kW, 3,200 kWh).

BRUSSELS, 1958

Good progress is being made in the construction of the British Industries Pavilion at the 1958 Brussels Universal and International Exhibition in which the electrical section will be the leading feature. Arrangements are not so far advanced, however, that it is too late for electrical manufacturers who have not already done so to come forward with their financial support. Although the exhibits in the section will not be individually labelled with manufacturers' names, a list of those who are participating will be prominently displayed and they will enjoy other benefits. The Organising Committee is at the B.E.A.M.A. offices, 36, Kingsway, London, W.C.2.

The display will demonstrate Great Britain's electrical achievements and this theme will be reinforced by a British Electrical Conference in the Exhibition Auditorium on 16th and 17th May next. At this gathering Sir John Cockcroft will present a paper on nuclear power and Sir Gordon Radley one on communications; the Conference will conclude with a reception. Both the electrical display and the Conference are being well publicised.

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An Electron Accelerator

By R. E. JENNINGS, Ph.D.*

DURING the war great advances were made in the development of pulsed sources of radio power at centimetric wavelengths for use in radar systems. When these sources subsequently became available for general use, they greatly assisted in the development of the electron linear accelerator and also made feasible a type of machine known as the microtron. The principle of operation of the microtron was established by Veksler in 1945[1] and the first machine of this type was constructed in Ottawa (Redhead *et al.*) in 1950.[2]

Essentially, the microtron is a resonant cavity in a constant magnetic field. When the cavity is fed with power at its resonant frequency, it develops an alternating field along its axis which is used to accelerate a bunch of electrons as they pass through the cavity. After leaving the cavity, the electrons are bent into a circular orbit by the magnetic field so that they re-enter the cavity and are further accelerated. Using a source of power of about 1 MW in the pulse it is possible to produce fields of about 1 MV/cm in the cavity, so that the increase in energy of an electron each time it passes through the cavity is considerable and of the order of its rest energy.

How a Cyclotron Operates

To understand the principle of operation of the microtron, it is useful first to discuss the mode of operation of a cyclotron, a machine for the acceleration of heavy particles such as the proton (rest mass = 1,836 × rest mass of the electron). In a cyclotron, the particles are accelerated by crossing the gap between two D's in a constant magnetic field. Due to the magnetic field, the particles follow a semi-circular path between successive crossings of the gap, the radius of which slowly increases (as shown in Fig. 1). The D's are flat, hollow cavities into which the electric field cannot penetrate so that the particles are only accelerated at the gap. The frequency of the radio power supplied to the D's must be matched to the time taken to describe each semi-circle so that the particles always cross the gap at the correct phase. The time to describe each semi-circle, given by $T = \frac{\pi mc}{Be}$ where m is the mass of the particle, c the velocity of light, B the magnetic flux and e the charge on the proton, must be equal to half the period of the r.f. supply. Note that this time is independent of the radius of the orbit, the increase in radius being exactly counterbalanced by the increase in speed of the particle. It is due to this fact that the cyclotron is able to operate at a constant frequency, the particles keeping in step as they are accelerated.

This state of affairs is only approximately correct, however, and as the velocity v of the particle increases, its relativistic mass, given by $\frac{m_0}{\sqrt{1 - v^2/c^2}}$ becomes appreciably larger than its rest mass m_0. Thus, T can no longer be considered constant, but slowly increases and the particle begins to get out of phase relative to the accelerating voltage. If it were possible to increase the voltage between the D's to such an extent that instead of getting out of phase slowly, the particle took an extra time corresponding to 360 deg of the r.f. to describe each successive semi-circular orbit, it would always arrive at the gap at the correct phase, and the difficulty would be overcome.

The voltage required for a cyclotron to operate in this way with protons is fantastic, being about 2,000 MV between the D's, but this is the idea upon which the microtron depends. In this case the particles being accelerated are electrons whose rest energy is equivalent to 511 keV. To increase their mass by their rest mass they have to be accelerated through a voltage of 511 kV. With a pulsed magnetron giving a peak power of 1 or 2 MW at a wavelength of 10 cm it is possible to create a field across the lips of a resonant cavity which corresponds to a potential difference of this order.

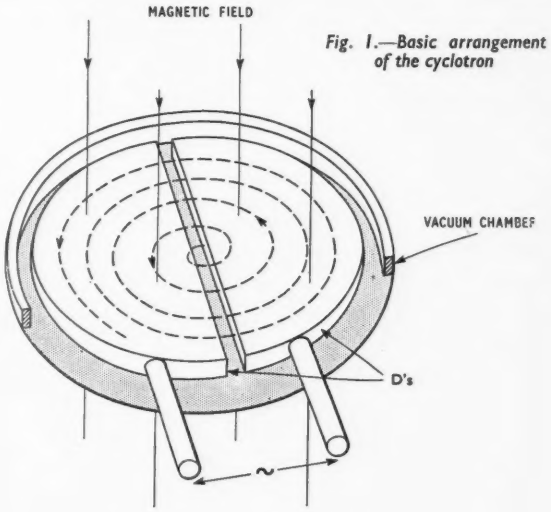

Fig. 1.—Basic arrangement of the cyclotron

Principle of Operation

The orbits in the microtron all have a common tangent along the axis of the resonator, as shown in Fig. 2. Assuming that the electrons start at rest on the left-hand cone, and gain an energy of 511 keV or one rest mass during their first transit, they leave the resonator with a total energy of two rest masses. The time for the electron to describe its orbit is directly proportional to the total energy of the particle and inversely proportional to the strength of the magnetic field. Thus, for the particle leaving the resonator with a total energy of two rest masses, the magnetic field can be adjusted so that the particle takes two periods of the r.f. field to describe the first orbit. It then re-enters the cavity in phase, gains energy equivalent to a further rest mass, leaves the cavity with a total energy of three rest masses and takes three periods to describe the second orbit and so on. In this way the electron stays in phase and continues to gain

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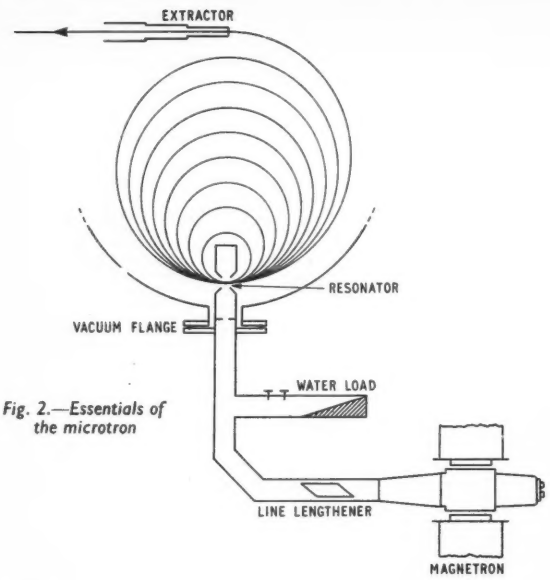

Fig. 2.—Essentials of the microtron

energy. Its velocity is soon very close to the velocity of light but the mass of the particle is increasing, its total energy being given by $E=mc^2$, where m is the mass of the accelerated electron.

The description given above is for an " ideal " electron. The amount by which an electron can deviate from the motion of the ideal electron has been shown[3] to result in energy variations of less than one-tenth of a rest mass, i.e. less than $\pm 0{\cdot}05$ MeV, and it is independent of the output energy. This means that the percentage variation decreases with increase in the final energy of a machine.

A number of different modes of acceleration are possible, the conditions that have to be satisfied for the magnetic flux B and the effective accelerating voltage V being given by:—

$$B = \frac{\omega c m_o}{e(a-b)} \quad .. \quad .. \quad (1)$$

$$V = \frac{m_o c^2}{e} \cdot \frac{b}{a-b} \quad .. \quad (2)$$

Here ω is the angular frequency of the r.f. supply and a and b are any integers such that $a>b$ and $b\geqslant 1$. The condition described above corresponds to $b=1$, $a=2$. This is the optimum mode as $(a-b)=1$, corresponding to the maximum value of B and therefore physically the smallest size of magnet for a given energy. The corresponding value of V is the smallest for all modes with $(a-b)=1$ and is given by $V=\frac{m_o c^2}{e}$ i.e. the energy eV gained per transit is equal to the rest energy $m_o c^2$.

The value of B is proportional to the angular frequency ω which should therefore also be a maximum. There comes a limit to what is practically possible and so far the maximum frequency used is 3,000 Mc/s for the modes characterised by $(a-b)=1$. It might be possible to use frequencies up to 5,000 Mc/s in this mode, but for higher frequencies the transit time for the first orbit becomes relatively too long with a resonator of reasonable design and it would also be difficult to make the first orbit clear the resonator.

For the optimum mode the value of B is 1,060 gauss/cm^2 for a frequency of 3,000 Mc/s. This is a comparatively low field so that the dimensions of a microtron magnet are correspondingly of an order of magnitude greater than for a betatron or synchrotron of the same energy. On the other hand, as the field is static, the magnet is very much cheaper to make and simpler to operate than the a.c. magnets used in these machines. This is a big advantage.

The magnet for microtrons of a few MeV final energy is straightforward in construction. An electromagnet is

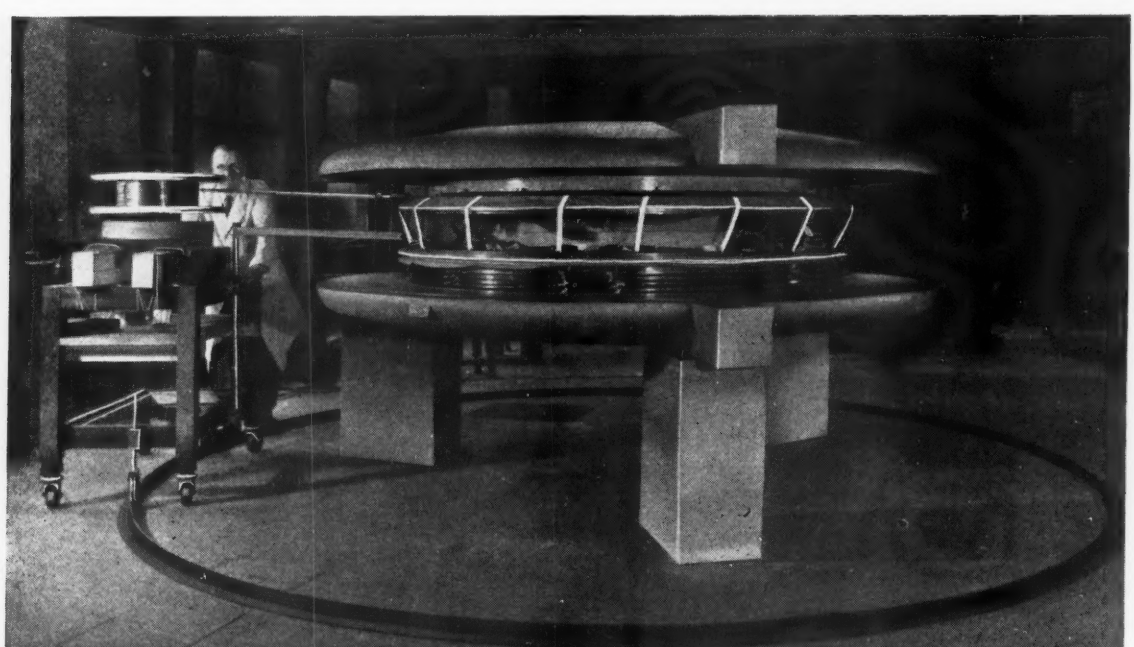

Fig. 3.—Coils being wound on to the magnet of a 25 MeV microtron at University College, London

preferable so that small adjustments can be made to the field. Between the circular poles of the magnet is placed the vacuum box. The body of the resonator is machined from a block of tellurium copper, through which a flat cylindrical hole is made. The conical poles are hard soldered to copper discs which are clamped into circular recesses on each side of the body of the resonator. The body of the resonator is soldered on to the end of a piece of waveguide, a coupling hole of suitable dimensions being cut at this point. The waveguide, fitted with a vacuum flange, passes into the vacuum box, the waveguide system being evacuated through the hole in the cones. The resonator is arranged to sit towards the edge of the magnetic field in the fall-off region so that the electrons are focused to the median plane. The power required to feed the cavity can be estimated by taking its shunt impedance as about 1 MΩ and the peak volts required at 600 kV. The power then required is about 0·18 MW during the pulse. However, using a magnetron as the source of r.f. power, and feeding from one resonant circuit to another, it is necessary to include a resistive element in the system to obtain stability. This takes about half the power, so 0·36 MW is required before taking into account the loading by the electron beams passing through the resonator. Thus, between 0·5 and 1 MW is necessary during the pulse. As the BM 735 magnetron used operates at a fixed frequency it is necessary to tune the resonator; this is done by a simple thermal arrangement which is slow but has no backlash.

Electron Emission

In the microtron an injection system is not essential as the field between the tips of the cones is so intense that sufficient numbers of electrons are emitted from the cones themselves. As only electrons from one of the cones can be used, to keep the loading on the cavity to the minimum it is essential to suppress the emission from the other cone during the alternate cycle. This is done by gold plating and polishing both cones and then inserting in the cone from which emission is required a thin aluminium sleeve, adjusted to protrude a few thousandths of an inch into the gap of the cavity. In this way a forward to backward ratio of about 20:1 can be achieved.

While emission of electrons in this way is simple it has a number of disadvantages. The electron emission depends upon the state of the emitting surface and is not easily controllable. The majority of the electrons are emitted at the peak of the sine wave and, taking a comparatively long time for the first transit, barely arrive inside the phase stable region. The electrons from the first orbit are diverging and have a wide energy spectrum; consequently only a small fraction of them continue into the second and later orbits. A number of attempts have been made to introduce a gun but without any great success. A suggestion by O. Wernholm of Stockholm[4] to use an L-type cathode pulsed at 80 kV and situated so that it gives a stream of electrons which is bent into an orbit of about 1 cm radius to arrive at the resonator in the correct direction looks the most promising, but the vacuum conditions would be far more stringent to avoid poisoning the cathode.

The microtron built at Ottawa in 1950 worked at a wavelength of 10 cm and the final energy of the electrons was 4½ MeV (kinetic). A similar machine was constructed at University College, London, and has been operating since 1951.[5] This machine was the first to be fitted with an extractor system which consisted simply of an iron tube put into the magnetic field to supply a field free path for the electron beam (see Fig. 2). In the microtron, extraction is simple because opposite the resonator the orbits are separated by about an inch ($\lambda = 10$ cm) and so there is sufficient room to insert a tapered iron pipe without disturbing the previous orbits appreciably. About 70 per cent of the beam is extracted in this way, the beam having a divergence of 1·5 deg in the horizontal plane and 0·3 deg in the vertical plane (semi-angles). The energy of the beam is 4½ MeV (kinetic) and the energy spread ±½ per cent. The energy of the electrons in the final orbit of a microtron (working at a given frequency and in a given mode) increases as the diameter of the poles of the magnet. At University College, construction has recently commenced on a 25 MeV machine. The poles

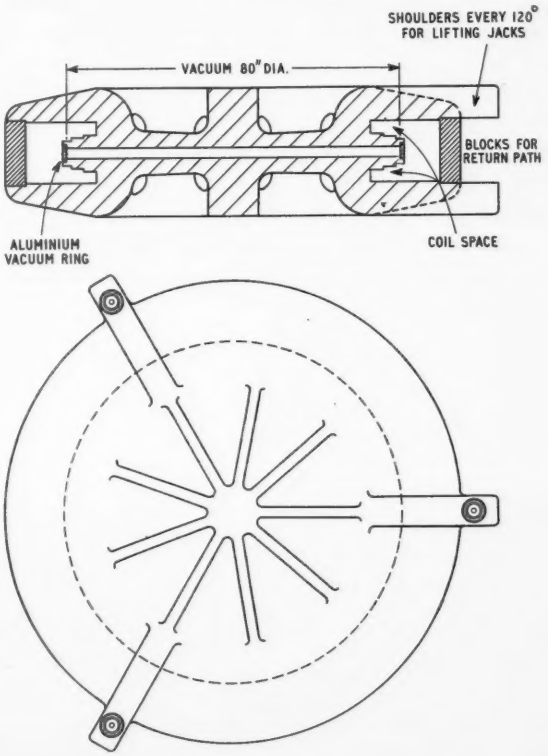

Fig. 4.—General design of a 25 MeV microtron magnet

of the magnet have been cast by Edgar Allen & Co., Ltd., and have a diameter of 80in. The poles themselves are to form the top and bottom of the vacuum chamber, the walls of the chamber being made from a strip of aluminium rolled and welded. The magnet windings are shown being put on the poles in Fig. 3. The winding gear consists of a trolley guided round the magnet. The trolley carries the reel of copper strip, which is fed out through a friction device at the correct level for each pancake.

In the photograph the poles are shown separated by wooden beams; in the final arrangement the poles are separated by blocks of dynamo steel around the periphery of each casting, these blocks also forming the return path for the flux. The general design of the large magnet is shown in Fig. 4.

There are one or two noticeable differences in the design of the r.f. system between the small and big machines. In the smaller machine the r.f. pulse is 2 μsec in duration. During the first μsec the voltage across the cavity is rising to its maximum value, leaving a μsec

for the acceleration of electrons. However, whereas in the smaller machine it takes only a very small fraction of a microsecond for any one electron to be accelerated to its final energy, in the larger machine this time is about $\frac{1}{2}$ μsec, so that a beam would only be obtained during the remaining $\frac{1}{2}$ μsec of a 2 μsec pulse. Because of this fact, it has been decided to use a 3 μsec pulse, in which case a beam is obtained for $1\frac{1}{2}$ μsec and the output is trebled. Another consequence of the longer time taken to accelerate an electron to its final energy is that, at the end of the r.f. cycle, the machine is full of electrons (all those emitted during the last $\frac{1}{2}$ μsec) of energies up to 25 MeV which will not be further accelerated, and which will finally hit the resonator to give an unwanted but quite intense beam in the backward direction. This can easily be avoided by arranging a pair of plates in an early orbit which can be pulsed $\frac{1}{2}$ μsec before the end of the r.f. cycle to deflect the electrons down into the pole. Thus, electrons which cannot be fully accelerated will be stopped at this point, and the energy of the electrons so stopped is comparatively low and screening against the consequent radiation, which is in the forward direction, is easy.

The big problem connected with the design of the 25 MeV microtron is the precession of the orbits through magnetic field irregularities or an overall tilt of one pole relative to the other. In particular, due to the small size of the hole in each cone compared to the final orbit diameter, it is important to prevent any precession of the orbits across the hole of the resonator. To avoid as far as possible any precession of this kind, both halves of the magnet were machined on the horizontal lathe with the point of entry of the resonator at the same orientation. Thus, any irregularities in the lathe bed, reflected in the contour of the pole faces, were evenly distributed about a line through the resonator normal to the common tangent. In this way the precession across the hole of the resonator should be reduced to the minimum and final corrections can be made with pole face windings.

Another set of concentric pole face windings, each separately energised, are to be mounted on each pole to " shim up " the drop of about one per cent to be expected at the centre of a magnetic field of this type which has a large diameter to gap ratio. In this way the precession about the resonator, which is not nearly so serious as that across the resonator, can be avoided.

Although the magnet is very large for an energy of 25 MeV when compared to, say, a betatron, it has a number of advantages. The magnet, being a d.c. magnet, is cheap and simple to construct and energise. Extraction of the beam should not be too difficult provided care is taken to see that the disturbance to previous orbits is not too serious and in particular to avoid as much as possible any movement *across* the hole of the cavity. To achieve this it will be necessary to mount a dummy extractor opposite to and in line with the extractor itself. The beam is expected to be very nearly mono-energetic and fairly parallel.

Applications

A number of microtrons have already been built in this and other countries. Some have been used to make further studies on this method of acceleration,[2,6] one is being used as an injector for a larger machine, while a number have been used to supply a beam of high energy electrons for experiments such as the scattering of electrons from atomic nuclei or the measurement of the X-ray beam produced when electrons are passed through matter. In all these experiments the electron beam falls on to a thin foil of material, often a thin sheet of metal, and the microtron is particularly suitable as its beam is very nearly mono-energetic and parallel. This simplifies the experimental apparatus considerably and also helps to reduce the background level of the Geiger or scintillation counter which is frequently used as the detector.

In the past, there has been considerable interest in the possible use of this type of machine in the treatment of cancer. The cost of production, as against a linear accelerator, is very much less because little high precision machining is required in its construction (the magnet tolerances are not very close if the final energy is not more than a few MeV). However, although the beam intensity can be increased by raising the pulse repetition frequency, etc., it is still not enough for medical purposes. If sufficient attention were paid to the problem of injection it is quite likely that the intensity could be raised as much as a hundredfold. This is a difficult problem, however, and until such time as it is solved, the linear accelerator is worth the extra cost where an intense beam is required.

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Snowy Scheme Agreement

THE Government of Victoria has approved in general the draft agreement on the use of electricity and water from the Snowy scheme, subject to clarification of certain points regarding the possibility of flooding on the Upper Murray River, but these points are expected to be settled very shortly.

Announcing this on 7th August, the Minister of Electrical Undertakings (Mr. G. O. Reid) said the draft agreement was a good one for Victoria. Snowy power, Mr. Reid said, would be shared on the basis of two-thirds to New South Wales and one-third to Victoria after the Commonwealth had taken what electricity it required from the scheme for use in the Australian Capital Territory and in and near the Snowy Mountains area. Commonwealth requirements were not expected to be large.

As far as practicable, the State Electricity Commission of Victoria and the Electricity Commission of New South Wales would be permitted to take their respective shares of electricity when it best suited their needs. Broadly, the financial clauses ensured that the cost of electricity to Victoria and New South Wales would be no greater by taking Snowy electricity than it would have been had each State continued to rely solely on its own resources.

The Snowy scheme would begin to supply electricity to Victoria in 1959. Initially, the output available to Victoria would be only 25 MW of peak-load power, but this share would progressively increase to 200 MW in 1963. The capital cost to the State if it had to provide an equivalent amount of thermal plant and related coal production assets would be some £25 million. Looking further ahead to the completion of the scheme—about 25 years hence—Victoria's share would be over 900 MW.

Work was already in hand, Mr. Reid said, on the power line to connect the Victorian system with the Snowy scheme. This line would be 62 miles long, and would operate at 330 kV. It would run from a new switching station at Dederang (near Kiewa) to the River Murray a few miles south of Towong, where it would connect with another 330 kV power line from the Snowy Mountains scheme. Viewed as an irrigation scheme, Mr. Reid said, the Snowy project would provide an extra 400,000 acre-feet of water a year diverted into the Murray, which would be shared by Victoria and New South Wales.

Low Carbon Steel Production

By R. W. EVANS, T.D., M.Met., F.I.M.

THE Battelle report on comparative economics of open hearth and electric furnaces for production of low carbon steels has performed a useful service for all countries in that it has highlighted those aspects of cost and operation which would affect a decision to use either the electric furnace or open hearth process in given circumstances. The *Electrical Review* also has enabled maximum benefit to be derived from the report by publishing articles dealing with it from different angles.

One feels that the report revealed a situation which had been suspected to exist for some time, i.e. that the electric furnace process for manufacture of low carbon steel in the U.S.A. was as economically attractive as the open hearth process. Indeed, the whole matter is summed up in the introduction. " Within the past few years, improvements in furnace design and operation have materially lowered electric furnace steelmaking costs to the point where use of this process in the production of plain carbon steels appears to be almost competitive with the open hearth."

THE AUTHOR DISCUSSES THE IMPLICATIONS OF THE BATTELLE REPORT ON THE USE OF THE ARC FURNACE

The electric furnace is a large consumer of electricity, so it was of great interest to electricity authorities and coal producers, let alone electric furnace and equipment manufacturers, to ascertain the facts of the situation. The Battelle report is the result. It is interesting to note that steel manufacturers had little hand in it despite the fact that they would have the maximum interest in its findings. It is also interesting that no significant expansion of electric furnace production in the U.S.A. has taken place as a result of the report. It is likely that the steel manufacturers had privately made similar comparisons to those published in the report and had come to their own conclusions.

The place of the electric furnace in British economy may be different from that obtaining in the U.S.A. For instance, quite apart from considerations of steel quality, relative prices of scrap and pig iron affect the economy, and these are given in the report as $43 per ton for steel scrap and $33 per ton for hot metal, a situation fairly remote from that prevailing in this country and on the Continent. If the electric furnace is happier on high scrap charges, from this point of view in the United Kingdom it should compare even more favourably with the open hearth process.

Quality Considerations

From the steelmakers' viewpoint one of the most important matters is the question of steel quality, and in the author's opinion the report has not dealt adequately with this aspect. To compare the electric furnace with the open hearth some thought must be given to the qualities of steel which can be best and most economically produced by each process and fit into the picture of probable future quality demands.

Carbon

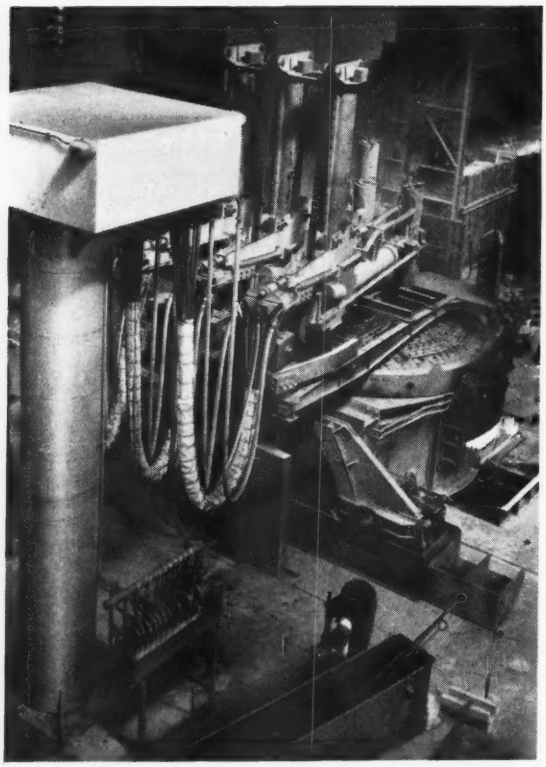
Primarily, the open hearth is a better oxidising process than the electric furnace, because its high melting temperatures produced by the flame depend on an excess of air being present, at any rate, with existing designs of furnace. During the melting operation, therefore, scale or iron oxide is formed on the surface of all scrap which, as melting proceeds, forms a slag along with smaller quantities of oxidised metalloids. Then, after the additions of cold pig or hot metal, this powerfully oxidising slag is able to start work right away in attacking the silicon, carbon, and manganese now introduced into the charge. Thus, one of the principal chemical ingredients required for the refining operation is automatically produced in the open hearth process during the heating and melting operation. This, however, is not so in the electric process, primarily because there is no excess air in the furnace and although there must also be some air diffusions, scaling of the charge is inhibited. Indeed, one must be careful not to have too high an oxygen potential in the furnace atmosphere because of oxidation loss of the electrodes.

Thus, those types of steel requiring high oxygen potentials for their production, i.e. low carbon rimming steels, are not so easily produced in the electric furnace; although the charge can be melted fast the later stages of the refining operation, say, from 0·12 per cent carbon down, are impeded unless helped artificially. Furthermore, a good rimming steel must be tapped in a highly oxidised state to promote and maintain a brisk rimming action so that apart from the elimination of carbon, finishing slags are required to be of an oxidising nature.

To produce such steels in the electric furnace at an economical rate it is *essential* to use oxygen. In the open hearth furnace it is a help, but in the electric furnace it is imperative. A source of oxygen must therefore be included in the capital estimate of such a plant if it is to be applied to low carbon steels. It is doubtful whether sufficient provision has been made in the report, both in capital and oxygen consumption, for this possibility. Difficulty in producing low carbons is in no way diminished by the tendency to pick up carbon from the electrodes so that carbons of, say, 0·04 per cent or less, are difficult to obtain in spite of heavily oxidising conditions.

Yields

The Fe content of the slag and the slag weight will determine the metallic yields obtainable. To drop carbon to low limits, the Fe in the slag must rise and the yield drop. For low carbon steels the comparisons of yields shown in the report are too favourable to the electric furnace, although due to lower slag volumes the electric furnace may have slightly less Fe loss. The use of hot metal will increase slag volumes in the electric furnace and under these circumstances there may be very little difference in the metallic yield. So far as the ingot yield is concerned, if large ingots are required, the electric furnace may be at a disadvantage in that with lower weight charges which is usually associated with it, a given ingot butt will form a larger percentage loss of the charge.



Top view of 60-ton swing roof arc furnace

Where hot metal or cold iron are used, the low oxygen potential of the electric furnace becomes a disadvantage in that phosphorus also must be oxidised and the phosphoric oxide can only be retained in a slag containing iron oxide, otherwise reversion occurs. It is true that by the use of multiple slags, phosphorus can be eliminated from the system, but it has first to be removed from the steel bath. In this country, using higher phosphorus iron than in the U.S.A., this will be a more important consideration. Whereas American practice may get away with one slag only, in this country multiple slags will be required both with regard to phosphorus and sulphur.

On the other hand, the production of balanced steels and steels with carbon contents in the region of 0·12 to 0·20 per cent will be comparatively easily produced in the electric furnace, although oxygen can be used with more advantage than in the open hearth process. These commoner steels can be produced with one slag and, therefore, faster and more economically.

Nitrogen

It must also be counted against the electric furnace that there is the possibility of nitrogen absorption by the steel due to fixation of nitrogen in the electric arc. The presence of even small quantities of nitrogen in such steels makes them prone to age hardening; the average nitrogen content in open hearth steels ranges from 0·0035 to 0·0040 per cent and even with these low figures loss of ductility in the sheet due to age hardening is sometimes encountered. Thus, basic Bessemer steels conventionally produced with blown air may contain up to 0·016 or 0·018 per cent N_2 which makes them totally unfitted for deep drawing purposes and even for most qualities of tinplate.

However, using a blast mixture of steam and oxygen in place of air, nitrogen contents as low as 0·002 per cent can be produced and the steel is then comparable with open hearth quality. Figures of nitrogen for electric furnace steels up to 0·006 per cent and even higher have been quoted, which would be a serious disadvantage for these qualities. One method of compensating for this condition would be to go even lower in carbon and/or phosphorus, but, as shown above, this cannot be a very attractive solution. If the steel is killed with aluminium to produce so-called " stabilised " grades in which nitrogen is not so deleterious, then the carbon content must be held to 0·06 per cent maximum in the killed pit sample so no further loss of carbon occurs in the moulds due to rimming. However, for rimming grades, nitrogen must be excluded as far as possible.

" Tramp " Elements

The presence of nickel and copper in these deep drawing steels must also be carefully watched. In the best grades limits of 0·10 per cent for each element are desirable with a maximum of 0·15 per cent for the two combined. Tin also should not be higher than 0·02 per cent. In a 100 per cent scrap charge for which ordinary grades of scrap have to be purchased, some difficulty may result, at any rate in the United Kingdom. For instance, open hearth charges using 50 per cent iron, 20 per cent mill scrap, and 30 per cent purchased scrap frequently run well over 0·10 per cent nickel and copper. However, if the electric furnace process is installed alongside a Bessemer plant, which can absorb only limited quantities of the scrap it produces, then the electric furnaces can be used to melt 100 per cent mill scrap. In this case nickel and copper difficulties will not arise. If duplex practice is used, then the danger of high nitrogen in steel, which persists from the Bessemer process, again arises, particularly if the metal is fully blown before transfer to the electric furnace. The Battelle report discusses the effect of nitrogen and " tramp " elements, stating that although nitrogen may be picked up in certain alloy steels this will not occur in plain carbon steels. In the author's view there is evidence that even in plain carbon grades there will be a pick-up of nitrogen. " Tramp " elements appear to exist in British scrap in greater quantities than in the United States, so that precautions necessary in America are doubly so in the United Kingdom. Thus, electric process scrap supplies must be rigorously inspected.

Temperature control of electric furnace steel is more precise than that of open hearth steel, so a greater proportion of electric furnace heats could be expected to tap within a given temperature range. This is undoubtedly beneficial for all grades of steel.

Refractories

As transformer capacities increase, enabling more power to be used and higher melting rates to be achieved, so the stress on roof refractories increases. In the open hearth furnace this difficulty (which is becoming more pronounced with higher rates of driving) can be met by installing an all-basic roof. Provided such roofs are maintained at high temperatures without cooling, they can be used with advantage, but with fluctuating temperatures they are liable to spall and have a short life. This disadvantage would appear to be inherent in electric furnaces with swing roofs and using no hot metal. If transformer powers are still further stepped up, roof life may become an important consideration.

For killed steels requiring low sulphur contents, and also for alloy steels, the electric furnace is unrivalled. The precise control of alloy content, temperature, state

of oxidation, and of sulphur elimination is of a considerably higher order than is possible in the open hearth furnace.

Continuous Casting

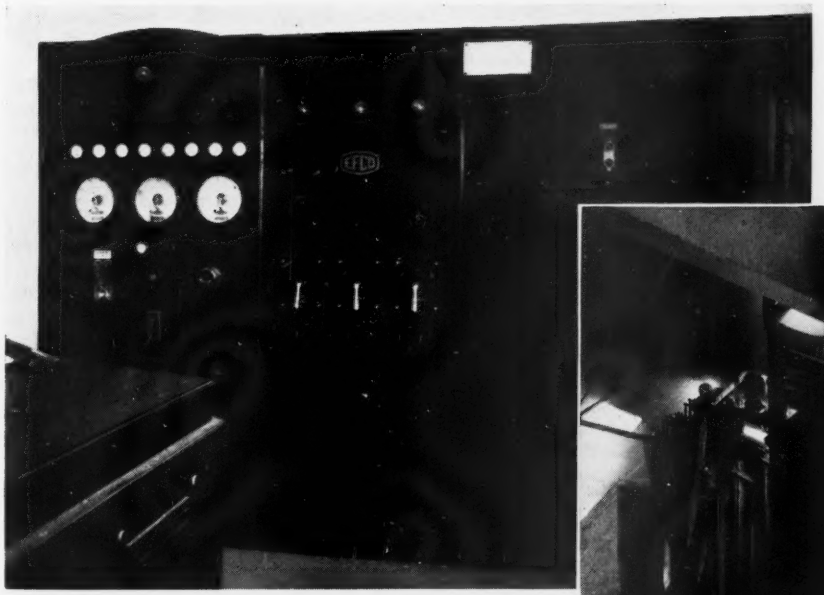
When the continuous casting process is perfected the handling of large tonnages of steel in one ladle may be a grave disadvantage and this will be experienced with large single-ladle open hearth furnaces. It would appear that the electric furnace has a definite advantage here because, even if its capacity is 200 tons, it can be tilted and the charge taken off, if necessary, in two or more ladles. Incidentally, such smaller batches of steel are more conducive to economy in soaking pit operation, eliminating as they do the very large pit installations which are required to cope with bunched conditions of large open hearth charges. These advantages are shared also by the Bessemer processes to which reference will be made later.

The whole question of quality of low carbon deep drawing steel must be judged in relation to the way in which future quality requirements are likely to develop. It seems probable that even greater ductility may be looked for in the future, which means that there will be no relaxation in the carbon, sulphur, nitrogen and tramp element specifications. It is doubtful whether much lower carbons can be produced economically in any steelmaking process due to the high states of oxidation which are necessary. Lower phosphorus helps the ductility and in this respect the 100 per cent scrap charge has the greatest advantage. For hot metal users the lower the phosphorus in iron the better. Sulphur limits are likely to be kept low.

Comparison with Bessemer Processes

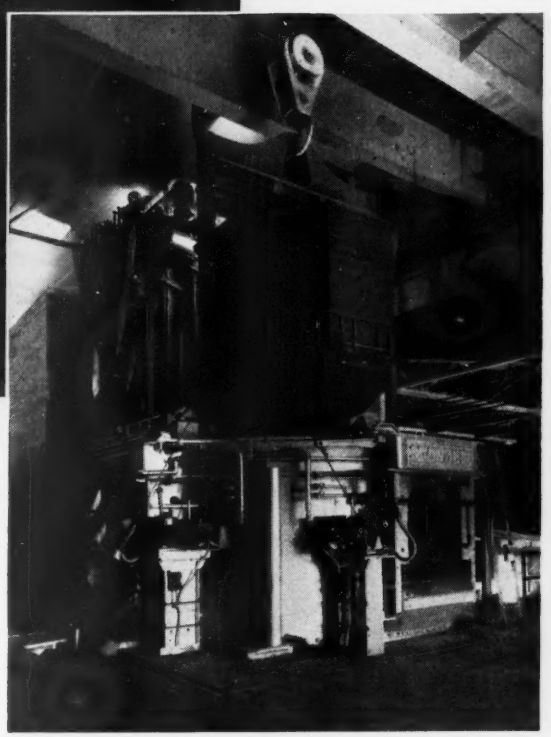
In the United States the wide strip mill era commenced before the last war; in Europe it is only just starting. It would appear, therefore, that the demand for low carbon steels is likely to rise steeply during the years to come, and that increases in ingot production will be largely in the low carbon grades. On the Continent, however, the electric furnace will have rivals other than the open hearth furnace in the newly developed oxygen blown convertor processes. These methods include top blown Bessemer convertors and the use of steam/oxygen or CO_2/oxygen blasts in the conventional bottom blown convertor, and are particularly suited to the production of low carbon steels with quality rivalling that of the open hearth. In these processes nitrogen contents in the steel of not over 0·003 per cent are produced as a matter of course, carbon contents are easily kept low, " tramp " elements are small, and at least half the sulphur in the charge can be removed. This means that if the pig iron contains 0·03 per cent sulphur the steel will contain not more than 0·015 per cent, but, on the other hand, phosphorus is likely to be higher, perhaps up to 0·025 per cent, even after double slagging. Nevertheless, the high speed with which some convertor steels are made make it difficult precisely to determine the end part of the reaction and to control its progression, so that the product is said not to be so consistent in quality as open hearth, and certainly not so compared with the electric furnace. For instance, a 50-ton heat blown with oxygen/steam in a conventional convertor can be expected to take not more than 10 minutes' blowing time, which is exceedingly fast conversion.

It is likely that further developments of these processes will take the form of perfecting instrumentation for the precise determination of temperatures during the blow, and of photometric and spectroscopic examination of the flame as a guide to the way in which reactions are proceeding. The extent to which these pneumatic processes



Left : Control panel of an electric arc furnace

Below : A 60-ton swing roof top charge arc furnace with the charging basket in position



develop will depend largely on the phosphorus content of the iron available. Thus, top blown oxygen steels for deep drawing cannot be successfully produced from higher than 0·35 per cent phosphorus irons whereas bottom blown steels, using air, will require not less than 1·8 per cent phosphorus. Enrichment of the blast with oxygen enables irons to be used containing as little as 1·6 per cent phosphorus, so there exists a gap in phosphorus content which the blown processes cannot at the moment fill.

Possibly not enough weight is given in the Battelle report to the Bessemer processes as a rival to the electric furnace. Even in the United States a number of top blown convertors are in operation and further installations are contemplated. These vessels can use 20 per cent or more scrap. In Europe also, where there is much high phosphorus ore, the Bessemer process flourishes and, in the author's view, is not likely to yield to the electric furnace.

Availability of Raw Materials

This brings us to the vast subject of the future availability of raw materials and of fuels. The greater part of the world's known iron ore reserves are in the low phosphorus class, giving about 0·1 to 0·3 per cent phosphorus in the pig iron. These are the old pre-Cambrian ores which comprise the Lake Superior, Labrador, Brazil and Venezuelan ores, among the more important deposits. Most of the world's known high phosphorus ores are situated in Europe. Such are the Jurassic ores of Oxfordshire, Northamptonshire and Lincolnshire, the Minette ores of Lorraine, and the Salzgitter ores of Germany. Although they are of different origin, Sweden also possesses resources of high phosphorus ores. In other parts of the world the Newfoundland and Alabama ores of the American continent are the most important.

This state of ore distribution has resulted in a distinctive pattern of steelmaking. In the United States the stationary basic open hearth furnace predominates, working on about 0·2 to 0·25 per cent phosphorus iron. In Europe the high phosphorus ores have led to the development of the tilting furnace and of the basic Bessemer process. On the Continent open hearth furnaces are generally associated with basic Bessemer plants and have a low phosphorus iron similar to that in the United States because the high phosphorus ore is applied solely to the Bessemer process. It is a sad fact that no open hearth furnaces in the world are now working with such high metallurgical loads as those in the United Kingdom. This does not seem a situation conducive to a large-scale development of the electric furnace in the near future either in the United Kingdom or, for that matter, on the Continent.

Availability of Energy

What may be an even more important aspect is the supply of fuel and energy, although this a long-term factor. According to the latest estimates* prepared by the U.S. Atomic Energy Commission and others, economic world reserves of the "fossil" fuels, coal, oil and natural gas, are now fairly well known. Based on forecasts of the increase of energy consumption per head of population, and of increases in population, it is estimated that by 1975 world reserves of fuel oil and natural gas will be reduced to the point that while there will be still fuel in reserve, the cost of production and price will be increasing. At the same time the cost of electrical energy from nuclear and hydro-electric sources will be decreasing.

Now it must be realised that open hearth furnaces depend entirely on "fossil" fuels or their derivatives for heat. There is no known method, and this seems a real difficulty, of furnishing the high-temperature heat required for steel-melting processes direct from a nuclear reactor. There is comparatively little difficulty in making electrical energy, however, from nuclear sources. Bearing in mind that in this country at least, production of coal is not likely to rise or its price to drop, and that its sulphur content is likely to increase, one cannot escape the conclusion that the next few decades will see electricity becoming the prime source of energy. This points inexorably to the eclipse of the open hearth furnace in favour of "pneumatic" and electric furnace production. The Battelle report rightly points out that prospecting for future reserves of fuel oil is likely to become progressively more costly. In the absence of any competitive source of energy such as nuclear or hydro-electric power the expenditure on prospecting may be deemed necessary, but with the cheapening of nuclear power the day when it is considered uneconomical to search for further oil supplies may be brought appreciably nearer.

It is quite easy to envisage a completely integrated iron and steel plant driven almost entirely by electricity. Electric blast furnaces can produce any quality of pig iron with the expenditure of about one-third the coke now used; furthermore, any carbonaceous fuel is satisfactory. Steelmaking will take place in electrically blown convertors alongside electric furnaces, where duplexing can be practised if necessary, but where process scrap is absorbed and no more. Ingots will be heated in electrically heated soaking pits, rolling mills will be driven electrically and all works transport will be electric. This assumes that, in the meantime, no fundamentally new process such as the conversion of ore directly into steel appears. The part that electric processes could play in such circumstances cannot yet be assessed.

Conclusions

While the Battelle report is welcomed for its unbiased analysis of the factors affecting the economy of electric furnace steel production in the United States, a review of steelmaking advantages and disadvantages of the electric furnace shows that in the United Kingdom and on the Continent the latest developments in the Bessemer type processes, coupled with the higher phosphorus ores existing, render the future prospects of the electric furnace more doubtful than they appear from the report. The largest expansion of steelmaking in Europe will probably be associated with wide strip mills and low carbon steels, another factor not wholly favouring the electric furnace. However, from a longer-term view, the availability of energy during the next few decades indicates that electric and Bessemer type processes may be expected to supersede the open hearth.

Acknowledgment is due to the Electric Furnace Co. for supplying the illustrations.

*L. R. Hafstad—Director, Division of Reactor Development A.E.C. Blast Furnace and Steel Plant, Feb., 1955, pp. 228 et seq.

City and Guilds Examinations

EXAMINATION dates in 1958, with regulations and fees, are set out in a booklet, "General Regulations," just published by the City and Guilds of London Institute, Gresham College, Basinghall Street, E.C.2.

A separate booklet (price 4s, postage 6d) gives the regulations and syllabuses for telecommunications and electrical subjects in 1957-58 and other publications include "Examination Results, 1956" and "Prize List, 1956," each of which costs 2s, postage 3d.

Yugoslavia as a Market

Some Guidance for British Exporters

By HENRY H. NIMMO

IN an attempt to break into the exciting but difficult market of Yugoslavia, some thought must be given to its social and economic background. First of all it must be remembered that it is still a comparatively young state. The total area is roughly the same as that of Great Britain and the population is about 17 million. Modern Yugoslavia, a Communist state, dates back only to the end of the second world war when Marshal Tito, leader of the National Liberation Forces, was proclaimed Prime Minister of the Federal People's Republic. There are few organisations in Yugoslavia which have been in existence for more than ten years.

The standard of living is well below that of most Western European countries. The monthly average wage in manufacturing, for instance, is DR.12,000 (£14 10s) and in order to obtain a reasonable standard of living, even executive personnel have spare-time jobs. This is possible because the normal working day is from 6 or 7 a.m. to 2 p.m., six days a week. There are practically no well-to-do people and very little class distinction. Education is compulsory; all children go to State schools and many attend State universities, but unfortunately for the technical progress of the country, too many students tend to read classics rather than technology.

The Government of Yugoslavia realises that wider economic relations with other nations are most desirable. The principle of a free exchange of goods is accepted and there is no tendency towards economic isolation, although for the time being only bilateral trade is entered into. In other words, agreement is reached on the probable pattern of trade between two countries for a period of twelve months. Once an "Agreed Minute" has been entered into, the Yugoslav authorities will place no obstacle in the way of its fulfilment and it is expected that under the terms of the present Anglo-Yugoslav commercial understanding, signed in Belgrade last April, there will be a two-way trade of some £16 million.

Government and Industry

Although Yugoslavia is Communist, industrial and commercial organisation is decentralised in a way unheard of in Iron Curtain countries. The Federal Government controls the economy through the preparation of broad annual plans and the formulation of various laws which ensure that these plans are largely adhered to. Manufacturing and commercial enterprises are independent of the Government in their day-to-day operations, and must act on their own initiative in order to compete with other Yugoslav and foreign firms. One must not, however, expect to find public companies; all but a small proportion of profits go to the State. Neither must one be surprised to find a head of an organisation who obviously did not graduate to his high office through purely personal endeavours in the field of management.

In addition to Europe, which has always been Yugoslavia's most important foreign trade partner, last year has shown a pronounced strengthening of relations with the Far and Near East. This is the result of a gradual increase in production of industrial goods, but the lack of experience in trading with these countries is a difficult problem for the export industries of Yugoslavia. It may also be added that whereas in 1955 economic relations with the Eastern European countries were limited, 1956 was characterised by a great activity in the expansion of trade and other co-operation with these countries. Re-export enterprises could be of interest to British exporters of non-embargoed goods in that these firms have close contacts with buyers in some Iron Curtain countries. By the way, exporters should not be misled by Yugoslavia's import statistics which show the United States and Soviet Russia as the main suppliers. Import trade with the U.S.A. consists largely of economic aid grants, and to a smaller extent this is also true of the U.S.S.R.

The Language Problem

The language, Serbo-Croat, presents difficulties for exporters who wish to do most of their own fact-finding. The Cyrillic alphabet is still in use in the eastern part of the country; fortunately, however, there are plans afoot to extend the use of the Latin alphabet to the whole of the country. German is used extensively, whilst in eastern parts (Belgrade) French is fairly widely understood.

The exporter without linguistic ability and therefore less inclined to do his own market research, will find that much useful information can be obtained by making his initial contacts with an "import-export enterprise," or "agency enterprise," almost all of whom correspond in English. A few words about the meaning of these imposing titles. Import-export enterprises (there are some 250) all specialise to some extent, and the bigger ones have highly qualified technical personnel on their staffs to advise customers in the purchase of goods, and to examine offers submitted by foreign firms. These enterprises do not represent foreign firms and as general importers do not promote the goods of any particular firm. In some ways these firms can be compared with the Crown Agents.

Agency enterprises, of which there are 57 at the present time, are set up especially to represent foreign firms on an exclusive basis in much the same way as representatives in other countries operate. Where it is necessary for these firms to carry stock, special permission must be obtained by them from the Chamber of Foreign Trade. This permission is normally granted and is in the form of a consignment contract, payment to be made as and when the goods are sold.

In contrast with commerce and industry, finance is a monopoly of the State in the form of the National Bank. One of the main characteristics of the foreign currency regulations is the equalisation of home and export prices which is effected by applying various coefficients. This means that the rates of exchange applied to foreign currency bought from exporters or sold to importers are not always the same but vary according to the products in question. Foreign currency is not allocated to import enterprises; a sales contract is therefore always between principals, the import enterprise having established the contact and being responsible for all pre-sales negotiations and after-sales service.

An exception was recently made to the National Bank's monopoly just mentioned. This concerns the electrical industry. Foreign currencies gained by this industry are

sold to the Foreign Trade Bank and credited to the account of the industry to pay for imports of machinery and equipment designed for expansion. It is understandable, therefore, that "Rade Koncar," one of the more important electrical manufacturers, has entered the export market although its capacity is not by any means sufficient to supply the home market. Another interesting position is the recent considerable foreign exchange which has been made available for the import of consumer goods such as domestic electrical appliances. The reason for this is two-fold: to improve the standard of living and to encourage the indigenous industries to compete with foreign producers in quality and price. This is very necessary as generally the native product has a definite "home-made" look about it, whilst the retail price is usually twice that of a similar British product, including purchase tax.

There are no import duties as such in Yugoslavia: taxation is assessed by means of the coefficients mentioned earlier. The method of assessment is to multiply the dinar equivalent of the c.i.f. price by certain factors. These range from 4 down to 0·5, the higher factor being for luxury goods; when the coefficient is less than one, the import of goods is in fact subsidised. Import licences are not in use; foreign currency allocations, to be obtained by the user, take their place. Consular invoices and certificates of origin are not required.

The Yugoslav market may be approached in three ways, depending upon the products one has to sell. The market for industrial equipment can best be explored by visiting or circularising the manufacturers likely to use the equipment and once initial orders have been booked, it will not be difficult to obtain the services of a good agency enterprise to look after subsequent sales. In the case of capital equipment, the initial approach will be more successful if directed to the import-export enterprises. When they can foresee a demand they will usually ask the importer to establish a form of sales arrangement with an agency enterprise.

To determine the sales potential for consumer goods, much labour can be spared by making direct contact with an agency enterprise which will undertake to investigate the usual sales outlets for these types of products. Useful tools for each of these methods are: the "Almanac of Mechanical and Electrical Industry of Yugoslavia," "Directory of Yugoslav Export-Import Enterprises," and the "Handbook on Agency Enterprises," all obtainable through the Commercial Department of the Yugoslav Embassy.

Two points in conclusion: it will be evident that the exporter must not approach this country with any preconceived ideas prompted by his experiences in other Western European markets and, in answer to a question: Yes, there is business in Yugoslavia—for those who regard themselves, in the true sense of the word, as "exporters."

Mechanical Engineering Research

THE work carried out at the Mechanical Engineering Research Laboratory of the Department of Scientific and Industrial Research at Kilbride, Glasgow, during 1956, is reviewed in "Mechanical Engineering Research 1956" (H.M. Stationery Office, 4s).

Fatigue of metals continues to be the main subject of research on the strength of engineering materials as it is the cause of about 90 per cent of the failures of machinery which occur in service. Investigations of the strength of a particular type of pin joint which had given trouble in service showed that its fatigue strength was much less than the theoretical value. Tests were carried out to find ways of improving the load-carrying capacity of such joints. It was shown that the fatigue strength of this type of pin joint could be increased as much as eight times by using an interference fit between pin and tongue in place of a sliding fit. For the particular dimensions and material of pin and tongue tested the best diameter of pin was one inch, and the best interference (for long life) was seven thousandths of an inch. Further tests are being made of joints assembled with sliding fit pins in interference fit bushes which would be suitable for joints which have to be reassembled.

Four techniques for measuring large water flows in pipes are being compared to find out which is the most accurate and most convenient to use. The first stage has been to study the methods in the laboratory, improving details of the techniques and investigating their accuracy by calibration against an absolute weighing method. The tedium of evaluating results from a number of propeller current meters has been eliminated by the development of electronic equipment for recording the rotational velocity of up to 21 current meters automatically. The equipment gives an immediate indication of the number of revolutions of each meter in a given time. Two major improvements have been made to the salt-velocity method. The first has been the design of a simple a.c. bridge for detecting the passage of the injected solution past the pairs of electrodes in the pipe, in place of the usual direct measurement of change in current. The bridge will detect a concentration of salt of one part in two million and its zero reading is independent of the conductivity of the water. The second improvement has been the design of a cartridge-operated valve for injecting a pulse of solution into the pipe in twenty milliseconds.

The salt-dilution method has also been studied and improved methods of volumetric analysis have been developed. Time and expense will be saved in large field trials by the use of a new integration method for calculating total flow from point readings in a circular pipe. The mean velocity can be determined from fewer point readings than equivalent methods with at least as great an accuracy. All these methods are being tried out simultaneously at a Scottish hydro-electric installation.

The technique developed in the laboratory for investigating the extent of the lubricant film in a journal bearing by using glass bushes and ultra-violet light has been employed in an investigation of bearing whirl. It is well known that in certain circumstances the fluid film forces in a bearing may lead to vibration of the shaft, causing failure of the bearing or inducing undesirable vibration in other parts of the machine, but relatively little is known about exactly why this happens. Under whirl conditions the oil film rotates in the bearing at approximately half the shaft speed and whirl starts when a non-dimensional group relating clearance ratio, viscosity, shaft speed and load reaches a critical value. In tests with a stiff shaft whirl was obtained only when the oil film was complete and did not occur when the film was of the usual incomplete form.

VIEWS on the NEWS

By REFLECTOR

MY notes of 21st June contained a mild protest against the attribution of fires to electrical causes as a means of accounting for the inexplicable. I did not deny that electrical fires occurred. Mr. J. A. Hill, Senior Government Electrical Inspector, Burma, does not agree with my contention that the position is not so grim as it is painted and refers to the number of fires which fire brigade authorities put down to electricity. He urges (and in this I thoroughly concur) that there should be more frequent inspection of electrical installations. Now that the National Inspection Council has got going we can look forward to more inspections of new installations. But it is, of course, the older ones which are likely to give more trouble and only propaganda or education will induce consumers to look to their wiring or call in competent men to inspect it.

Mr. Hill thinks that if the electricity authorities were more active in this direction it could truthfully be said "an electric fault did not cause this fire," though I think that establishing this would still be as difficult as proving that a fire was caused electrically.

* * *

One day last week the *Evening Standard* said:—

"Trolley-buses in West London were halted to-day when a trolley-bus jumped the wires at Shepherds Bush Green."

If the vehicle had really performed such a feat the note was too brief; but as all that really happened was a "dewirement" and the hold-up couldn't have lasted for more than about a minute even a four-line paragraph was too much.

* * *

To celebrate its centenary the *City Press* has issued a special number in which there are some fascinating articles on various aspects of the City of London during the last hundred years. It is a reminder that many London institutions are national or international in character and that London, in spite of the vicissitudes of recent years, is still the world's principal centre of many activities. The publication also presents a number of facts about progress during the last century. Maybe it is under this heading that the growth of the Civil Service from 16,000 in 1857 to 559,000 in 1956 falls.

* * *

Russian scientists appear from an article by Dr. K. Mendelssohn, F.R.S., in last Sunday's *Observer* to be something of a privileged class—they certainly form a well-paid one. Dr. Mendelssohn, who is Reader in Physics in the University of Oxford, says that while an unskilled labourer earns 600 roubles a month, a young physicist fresh from the university has 2,000. With a research degree, his income rises to 3,000 and with a lectureship to 4,000. A reader earns 5,000 and a professor 6,000, to which an extra 3,000 is added if he is elected to corresponding membership of the Academy, or 6,000 if a full member. The more outstanding physicists will often hold two professorships simultaneously and their income can thus rise to 15,000 roubles a month and as much as 30,000 is possible.

The author says that the ratio between the pay of unskilled labour and a good, but not the best, physicist's salary works out at 1 to 5 for the United States, 1 to 7 for Great Britain and 1 to 25 for the Soviet Union. This, the author considers, is why the Russians have succeeded in directing their best brains into their scientific effort.

* * *

At Kilmarnock a month or so ago a young girl was killed by electric shock when she came into contact with a live electric wire in a house which was being demolished. I seem to recall a similar case in London four or five years ago. It would appear to be a routine matter for those responsible for such buildings to see that all services are properly cut off, but no doubt oversights will occur from time to time. In the Kilmarnock case an inquest jury reminded owners of their obligation in this respect and the South of Scotland Electricity Board has asked local authorities in its area to give it written notice of their intention to demolish buildings so that it can take the necessary steps to ensure that the services are sealed off.

* * *

According to the *Southern Weekly News* (Brighton), "every time a thunderstorm rumbles across the village of Lavant, lightning strikes the overhead electricity cables" and cuts off the supply. A member of the Chichester Rural Council told the Council that when a woman protested at the electricity offices

"the man behind the desk took instant umbrage. . . . He said: 'It is nothing to do with us. It is an act of God.' It struck me as a retrograde way of passing the buck."

* * *

In the *Electrical Review* of 26th August, 1887, the following strange recipe was given:—

"Mr. Merritt, of Somerville, Massachusetts, has patented a new insulating material for conductors and electrical apparatus. It is made in the following proportions:—Two pounds of silicate of soda are mixed with water, to this is added a pound of tar; the composition is then heated and with it are amalgamated four pounds of powdered amianthus (silicate of magnesia), and one ounce of sugar. When these ingredients are thoroughly blended, about one-tenth of an ounce of nitric acid diluted in warm water is added. It is stated that this composition is flexible, easily applied, and fairly tough, but it possesses the disadvantage of being unable to resist high temperatures under which it speedily liquefies."

Locomotives for Jamaica

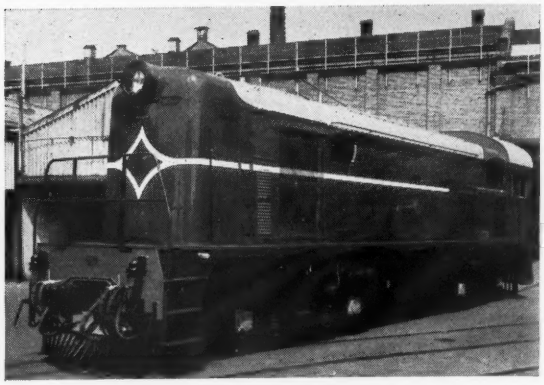
Diesel-Electric Units for Passenger and Freight Service

AN order for ten 750 h.p. diesel-electric locomotives has just been completed by the English Electric Co., Ltd., for the Jamaica Government Railway. The general arrangement of these locomotives is shown by the accompanying illustration. The superstructure is carried on two two-axle bogies, each axle being driven by a nose-suspended motor.

The locomotives are powered by English Electric 6 SRKT engines, having a continuous traction rating of 750 b.h.p. at 850 r.p.m. The engine is a six-cylinder in-line four-stroke unit, pressure charged by an exhaust gas turbo-charger, solidly coupled to a flange-mounted single bearing generator. The complete power unit is mounted on resilient supports which relieve the engine from stresses set up by any flexure of the underframe. Power from the main generator is transmitted to the road wheels through four six-pole axle-hung traction motors, driving the axles through single reduction spur gearing. The motors are permanently connected in series-parallel, with three stages of field weakening to make full engine output available up to 50 m.p.h.

Control of the locomotives is simple. The driver has, apart from the brake controller, a compact power controller which has two handles. One of these is used for setting the reversers for the required direction of travel, and the other controls the power developed by the engine.

The locomotives are universal units suitable for both passenger and freight trains and having a power sufficient to improve on existing steam locomotive performance while still being economical in shunting service, thus enabling the fullest use to be made of the high availability inherent in a well-designed diesel-electric locomotive, and enabling one standard type of unit to fulfil all traffic requirements with attendant advantages in rostering and maintenance.



One of the ten 750 h.p. diesel-electric locomotives for Jamaica

Although a maximum trailing load of 150 tons per locomotive was specified for operation over the hill sections, tests at site have enabled a load limit of over 200 tons per locomotive to be established for these sections. This compares favourably with the normal limit of 150 tons for existing 110 ton eight-coupled steam locomotives. Multiple-unit operation enables double headed trains of up to 430 tons to be hauled up the long 1 in 30 gradient between Porus and Williamsfield when working the alumina traffic, a performance which has relieved a bottleneck that threatened to dislocate traffic as the output of alumina increased.

Letters to the Editor

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Flameproof Apparatus

THERE is one small point in the article on " Flameproof Apparatus " by Messrs. Anderson and Carter in your issue of 19th July which requires clarification.

The authors refer to the fact that the breadth of all joints and the length of the flameproof path are determined according to the volume of the empty casing. This was correct so far as the previous issue of B.S. 229 was concerned, but the 1957 edition recently published does not refer the breadth of joint to the volume of the empty casing.

One important change in the new Standard relates to the acceptance, for metal-to-metal joints, of a ½in flange or joint breadth for normally air-filled apparatus for Groups I, II and III (a). Where Group III (b) gases (town gas and coke oven gas) are present, the 1in flange is now demanded irrespective of the volume of the internal casing. This differs from the earlier Standard inasmuch as the ½in flange was permitted only for Groups I, II (a) and II (b), and for the other Groups the breadth of all joints was then permitted to be either ¾in or 1in, depending upon the internal volume of the casing.

Complementary to the wider introduction of the ½in flange, the maximum permissible gap dimensions are quoted as 0·016in for Group I, and 0·006in for all other Groups where the ½in flange is acceptable; for the 1in joint, the maximum permissible gap dimensions remain as before.

This has, perhaps, arisen due to the fact that the article was prepared before the issue of B.S. 229 : 1957.

London, N.14. D. A. STRACHAN.

A copy of Mr. Strachan's letter was sent to the authors who reply as follows:—

Our thanks are due to your correspondent, Mr. D. A. Strachan, for pointing out the changes in B.S. 229:1957. The article was certainly prepared well before publication of the new specification. Apologies are due for not giving the date of the specification to which references were made.

Wakefield. J. W. L. ANDERSON and H. J. CARTER.

Next Week's issue will include an illustrated preview of electrical, welding and allied equipment to be shown at the Engineering, Marine, Welding and Nuclear Energy Exhibition (Olympia, 29th August to 12th September).

Trends in the design of radio and television equipment seen at the Radio Show at Earls Court (28th August to 7th September) will be reviewed in the same issue.

Domestic Electricity Survey

RESULTS OF CONSUMPTION ANALYSES

THE largest systematic survey of domestic electricity consumers yet undertaken was carried out by the Utilisation Research Committee of the Central Electricity Authority and Area Boards in 1955. At the time there were about 12 million domestic consumers in England and Wales and a uniform sampling fraction of one in every thousand was taken. The information obtained from the aggregrate sample of nearly 12,000 is considered to reflect the true position with satisfactory accuracy.

Based on the survey, an assessment of electrical appliance saturation factors and other data was published last year (*Electrical Review*, 4th May, 1956, page 711) and this has now been followed by an interim report which gives the results of consumption analyses by the method of simultaneous equations first applied in connection with the E.R.A. survey of 1946 (Utilisation Research Report No. 4), yielding the average annual consumption per consumer possessing specified electrical appliances. The consumers are also segregated by region, type of meter, number of rooms, economic status and size of household. It is estimated that in 1954-55 some 30 per cent of the total domestic consumption was used for lighting and miscellaneous appliances, 25 per cent for cooking, 20 per cent for water heating and 25 per cent for space heating.

As only such records were used that gave the consumption for a whole year, the analyses had to be confined to about 90 per cent of the sample, the balance representing consumers who had moved during the year or for whom the period for which meter readings were available deviated excessively from twelve months. For individual quarters the proportion of unsuitable records was even greater. The usable records gave an average of 1,540 kWh/consumer, which is just over 9 per cent higher than the official figure of 1,415 kWh/consumer, but the latter is based on the number of consumers at the end of 1954-55. Based on the middle of the year, the average would be some 1½ per cent higher, thus reducing the discrepancy to about 7½ per cent, attributable partly to sampling errors and partly to the unavoidable omission of a proportion of annual consumptions. To make some allowance for this discrepancy, all computed figures have been reduced by 5 per cent. These adjusted figures, the report points out, are still subject to varying margins of error, which are inherent in the method of analysis, but it can be assumed that if the whole investigation were repeated on a new sample a few years hence the trends would emerge with good accuracy.

Analysis by Appliances

Table I shows the appliances and combinations for which average consumptions were computed. All those not specified are included in the item "Lighting and Sundry." Although the weighted averages for "South" and "North" combined do not exactly equal the results of the separate computation of the combined data, the agreement is generally good. "South" covers the Areas of the London, South Eastern, Southern, South Western and Eastern Boards. Revised figures will be given in a further interim report.

The figure of 470 kWh under "Lighting and Sundry" contains the consumption of radio and television sets, irons, refrigerators, large self-contained water heaters, and various small appliances, according to the respective saturation factors. An attempt was made to separate out television sets and refrigerators, but the result of 250 kWh per television set and 580 kWh per refrigerator appeared to be spurious. The I.T.A. estimates the average daily use of a television set at 3·4 hours which, assuming an average wattage of 120, would correspond to only 150 kWh/year. The actual result could only be explained by the fact that families with television sets go out much less and thus use relatively more heating, cooking, lighting, etc. As for refrigerators, although an absorption model can easily consume some 1,000 kWh/year, less than one-third are of this type, and it may be that the estimate of 580 kWh was affected by the higher level of consumption associated, in general, with the possession of a refrigerator.

Table I.—Average Consumption for Specific Uses

Appliance	Proportion of Consumers, %			Average Annual Consumption, kWh		
	All	South	North	All	South	North
Lighting and sundry*	100	100	100	470	480	460
Cooker:						
Any	24·6	25·6	23·8	1,290	1,420	1,170
Full-size	21·0	22·9	19·4	1,390	1,500	1,280
Breakfast	3·6	2·7	4·4	720	810	670
Full-size cooker:						
Without kettle	4·4	3·4	5·2	1,490	1,790	1,330
With kettle	16·6	19·5	14·2	1,340	1,440	1,230
Without sink heater	19·4	20·3	18·7	1,400	1,530	1,290
With sink heater	1·6	2·6	0·7	1,130	1,200	930
Without gas ring	18·1	20·0	16·6	1,430	1,510	1,350
With gas ring	2·9	2·9	2·8	1,020	1,330	760
Kettle:						
Any	30·3	31·8	29·1	190	—	—
Without cooker	13·7	12·3	14·9	220	—	—
With cooker	16·6	19·5	14·2	160	—	—
Immersion heater	16·7	14·2	18·6	1,220	1,410	1,100
Sink heater:						
Any	3·1	4·8	1·8	760	750	780
Without cooker	1·6	2·3	1·1	980	1,000	930
With cooker	1·5	2·5	0·7	530	520	570
Wash boiler	11·8	11·7	11·8	230	210	240
Space heating:						
Any	61·5	64·1	59·3	600	760	460
Up to 1 kW	23·9	23·9	23·9	125	165	100
1·1–3 kW	25·8	25·5	26·0	450	610	340
3·1–5 kW	7·7	9·5	6·2	1,150	1,230	1,050
Over 5 kW	4·1	5·2	3·2	3,200	3,340	3,030

* Including radio and television sets, irons, refrigerators, large self-contained water heaters and sundry small appliances.

Table II.—Analysis of Space Heating Consumption, kWh/annum

Installed Space Heating Load	All			South			North		
	Per consumer	Per heater	Per kW	Per consumer	Per heater	Per kW	Per consumer	Per heater	Per kW
All	600	410	260	760	455	300	460	300	210
Up to 1 kW	125	125	130	165	165	180	100	95	100
1·1–3 kW	450	310	205	610	400	270	340	240	155
3·1–5 kW	1,150	445	325	1,230	460	360	1,050	425	280
Over 5 kW	3,200	700	490	3,340	770	615	3,030	670	385

Table III.—Seasonal Variation of Space Heating: Percentage of Consumption in each Quarter

Installed Space Heating Load	Quarters			
	June	Sept.	Dec.	Mar.
All	19	13	27	41
Up to 1 kW	12	0	31	57
1·1–3 kW	19	14	26	41
3·1–5 kW	20	13	26	40
Over 5 kW	20	14	27	39

Large self-contained water heaters can be estimated to contribute about 30 kWh to the figure of 470 kWh.

The average annual consumption of a full-size cooker is about 1,500 kWh in the south and 1,300 kWh in the north (where association with a solid-fuel range is more frequent), the overall average being about 1,400 kWh. A breakfast cooker consumes, on average, about half as much. More than three-quarters of all full-size cookers are associated with an electric kettle. Its presence appears to cause a reduction of about 150 kWh in the cooker consumption proper, whereas an electric sink heater reduces the cooker consumption on the average by something like 300 kWh.

Space Heating

While on average any consumer with one or more electric space heaters consumes about 600 kWh/year, south and north differ substantially, the corresponding averages being about 750 and 450 kWh/consumer. This differentiation is also maintained in the averages given for four classes of installed space heating load per consumer. Consumers with not more than 1 kW (representing nearly a quarter of all domestic consumers) take, on average, 160 kWh in the south, 100 kWh in the north, and 125 kWh combined. At the other end of the scale, consumers with more than 5 kW installed (about 4 per cent of all domestic consumers) take some 3,350 kWh in the south, 3,000 kWh in the north, and 3,200 kWh overall.

Space heating consumption is further analysed in Tables II and III. It will be seen that not only is the average consumption per consumer having one or more space heaters much higher in the south than in the north, but also the consumption per heater (about 450 kWh against 300 kWh) and the consumption per kW installed (300 kWh against 210 kWh). The latter figures correspond, incidentally, to utilisation factors of about 3½ and 2½ per cent. The disparity between south and north is highest for the lowest class. In both cases the utilisation factor rises steeply with the installed load. However, in the absence of any information about the use made by the four groups in very cold weather, no inferences on effective load factors can be drawn.

The report also analyses average annual consumptions according to type of account (credit or prepayment) and economic status of consumers. About 20 per cent of all consumers are stated to have prepayment meters. Whereas average "Lighting, etc." consumption is higher for credit consumers, cooking consumption shows an opposite trend, being some 25 per cent higher for prepayment consumers. This is only partly attributable to the difference in the average size of household, which is 3·18 for credit and 3·44 for prepayment consumers. Between "up to three" and six rooms the cooking consumption grows in both cases with the number of rooms, the corresponding size of household being 2·4 and 3·3 for credit and 2·4 and 3·8 for prepayment consumers. Average water heating consumptions are again generally higher for credit consumers, but with space heating the four- and five-room classes provide an exception. A good many of the dwellings with up to three rooms, especially in the case of credit consumers, are flats.

Regarding economic status, the report admits to the possibility of a considerable margin of error in the actual classification, which was left mostly to untrained interviewers. Cooker saturation falls consistently from about 40 per cent in the highest class to 15 per cent in the lowest, but the average middle-class consumption is some 10 per cent lower than for working-class consumers. One reason may be that the average size of household in the case of the former is 3 and of the latter 3·4.

With regard to water heating, a saturation factor of nearly 60 per cent for the highest class is accompanied by an average consumption well over twice that for working-class consumers, for whom the saturation is 15 per cent. Some 90 per cent of "well-to-do" consumers use electric space heating of some sort, the average consumption being four times as much as for the working classes, less than 60 per cent of whom have electric space heaters.

A further analysis shows that space heating can be estimated to account for approximately 27 per cent of the consumption in the south and only 18 per cent in the north, the disparity being offset mainly by the share of "Lighting, etc." Some 40 per cent of the rural consumption is due to cooking. The classification by economic status shows a remarkable variation in average annual consumption, ranging from over 5,000 kWh per consumer for those classified as "well-to-do" to about 600 kWh for the lowest class. "Lighting, etc." accounts for about one-third of the former and over 40 per cent of the latter figure; the share of the cooking consumption ranges between 15 and about 30 per cent; and water heating between roughly one-quarter and one-tenth. The proportion attributable to space heating is highest, about 30 per cent, for the middle-class group. The segregation of the working-class group by size of household reveals that over half of the relatively low average consumption of single-person households is used for water and space heating, and only 15 per cent for cooking. In the range from two to five persons, the proportion of cooking consumption grows slightly with size of household. The percentage consumption for water heating remains approximately constant, whereas the share of the space heating consumption shows a tendency to fall.

Finally, a comparison is made with some results of the E.R.A. surveys of 1946 and 1948.

I.E.E. SECTION VISITS

ONE HUNDRED members of the Supply Section of the Institution of Electrical Engineers, London, are visiting Belgium with their ladies from 5th to 9th September. Their programme will include visits to the Ateliers de Constructions Electriques de Charleroi, the Waterloo museums and battlefield, the Interbrabant Drogenbos power station, the Colonial Museum at Tervueren, the Cerabel porcelain works, Baudour, and the Castle of the Prince de Ligne. They will also attend a gala concert by the Grand Symphony Orchestra of Belgium and enjoy conducted tours of Ghent and Bruges.

The party will be led by Mr. S. E. Goodall, a vice-president of the Institution and a director of W. T. Henley's Telegraph Works Co., Ltd., Mr. P. J. Ryle, chairman of the Supply Section, and Mr. W. K. Brasher, C.B.E., M.A., M.I.E.E., secretary of the Institution.

Members of the Radio and Telecommunication Section of the Institution will make a four-day tour of the Netherlands starting on 18th September. There will be 100 members and about 80 friends, and groups will visit the Airborne Cemetery at Arnhem, the Zuider Zee, Hoge Veluwe National Park and the Van Gogh Art Gallery, the telecommunications factory at Hilversum, a gramophone record factory at Baarn, the K.E.M.A. laboratories, a transistor factory at Nijmegen, the Philips Research Laboratories and other establishments. There will be a dinner-dance at the Hotel Krasnapolsky, Amsterdam, and visits to places of interest.

The party will include the President of the Institution, Sir W. Gordon Radley, Ph.D.(Eng.), Director-General of the British Post Office; the president-elect, Mr. T. E. Goldup, C.B.E., chairman of Mullards, Ltd.; Sir Harold Bishop (B.B.C.); Dr. R. C. G. Williams (Philips Electrical, Ltd.), chairman of the Section; and Mr. W. K. Brasher.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Lord Brabazon of Tara has been elected President of the Radio Industry Council in succession to Sir Edward Appleton. Lord Brabazon is to open the Radio Show at Earls Court, London, on 28th August. His connections with the radio industry include a directorship of one of the leading manufacturing companies and the presidency for a time before the war of the former Radio Manufacturers' Association.

Mr. George B. Campbell has been appointed secretary of the Radio Industry Council in succession to Mr. Rupert P. Browne, who has retired through ill-health. Mr. Campbell, who has been acting secretary for some months, is a native of Edinburgh and was educated at George Watson's College. He became assistant secretary in 1940 of the Radio Manufacturers' Association (an organisation

Lord Brabazon

Mr. G. B. Campbell

which was succeeded by the Radio Industry Council), after a number of years in the industry, including two in the United States.

Mr. Browne became the first secretary of the R.I.C. in 1945, after having been associated since their inception with the various organisations which the Council replaced. He joined the first of these, the National Association of Radio Manufacturers, in 1924. Mr. Browne was awarded the O.B.E. for his work in connection with the training of technical personnel during the 1939-45 war.

Col. R. P. W. Adeane has been appointed chairman of Ransomes & Rapier, Ltd., in succession to the late Mr. R. R. Stokes.

Mr. R. Craig Wood, managing director of the Hotpoint Electric Appliance Co., Ltd., has accepted an invitation to address the annual conference to be held jointly by the European Society for Opinion Surveys and Market Research and the World Association for Public Opinion Research. The conference takes place in Gothenburg, Sweden, from 26th to 30th August, and Mr. Craig Wood's address will follow the official opening by the Swedish Minister for Commerce, Mr. Gunnar Lange. His topic will be: "What Top Management can derive from Market Research."

Mr. R. W. Evans, T.D., M.Met., F.I.M., who writes in this issue on "Low Carbon Steel Production" (page 313), graduated at Sheffield University in 1924 and was awarded the silver prize of the City and Guilds of London in iron and steel manufacture. He began as a trainee assistant in the blast-furnaces department at the Dowlais works of Guest, Keen & Nettlefolds, Ltd., became assistant manager of the Bessemer department in 1927 and night manager of the Rail Mill in 1929. On the formation of Guest, Keen & Baldwins Iron & Steel Co., Ltd., in 1934 he went to Margam Works, Port Talbot, as assistant melting shop manager, and became melting shop manager in 1937. He was promoted in 1943 to superintendent of melting shops and took part in the planning and design of the Abbey melting shop, which started operations in April, 1951, under his supervision. In 1955 he was appointed assistant general manager (operations) of the Steel Division of the Steel Company of Wales, Ltd.

Mr. R. W. Evans

Mr. J. E. Mountain, secretary of the Radio and Television Retailers' Association, has been elected a Fellow of the Chartered Institute of Secretaries.

The National Coal Board has appointed **Mr. C. G. Simpson,** O.B.E., to be director-general of staff, and **Mr. J. V. Wood,** director-general of industrial relations. Mr. Simpson, who is at present deputy director-general of the Staff Department, succeeds Mr. J. O. Blair-Cunynghame, who was recently appointed by the Minister of Power to be a member of the Board. The new appointment takes effect immediately. Mr. Wood, staff director of the Board's Northern (N. & C.) Division, will take up his new appointment on 18th November. He succeeds Mr. A. Walsh, who is to become deputy chairman of the South Western Division.

Mr. A. M. A. Majendie, M.A., and **Mr. L. C. Harman** have been appointed to the board of Smiths Aircraft Instruments, Ltd.

Mr. Majendie, who joined Smiths in 1954 from B.O.A.C., has been closely connected with the development of the Smiths Flight System. In B.O.A.C. he was flight captain of the Corporation's Comet fleet. He received the Queen's Commendation for valuable service in the air in 1953 and the Gold Medal of the Institute of Navigation a year later for work in connection with the navigation of jet transport aircraft. He is president of the Institute of Navigation.

Mr. Harman, who joined the Accounts Department of Smiths shortly after leaving school in 1924, was recently appointed to the board of Waymouth Gauges & Instruments, Ltd., one of the Smiths group of aviation companies.

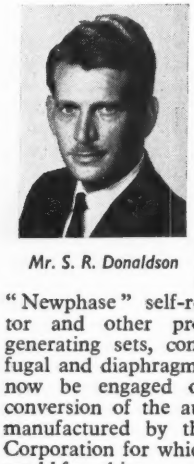
Mr. W. P. C. Orchard, who has been appointed manager of the Salisbury District of the Southern Electricity Board in succession to the late Mr. R. A. McCulloch, has been commercial engineer in the district since 1950. He was previously with the Edmundsons group and was successively manager of their Andover, Marlow and Frome districts.

We reproduce a photograph taken on the occasion of a recent visit to the Hersham works of the **Electric Furnace Co., Ltd.,** of three Russians interested in heating equipment for automobile factories. Dr. Shepeliakovsky, one of the visitors, is in

Mr. Zolotov (interpreter), Dr. Shepeliakovsky and Messrs. Gamage (sales manager, Electric Furnace Co.), Gifford (contracts manager), Ovsepian, Stokes (works manager) and Prusov

charge of the electric heating department of the Likhachov Autoplant Factory, Moscow.

Mr. S. R. Donaldson, A.M.I.E.E., has been appointed general manager of Newage (Manchester), Ltd. He was formerly chief development engineer for the Newage Group and was in charge of the Research and Development Department, Stamford. Mr. Donaldson was responsible for the design of the "Newphase" self-regulating alternator and other products, including generating sets, control gear, centrifugal and diaphragm pumps. He will now be engaged on the industrial conversion of the automotive engines manufactured by the British Motor Corporation for which Newage hold a world franchise.



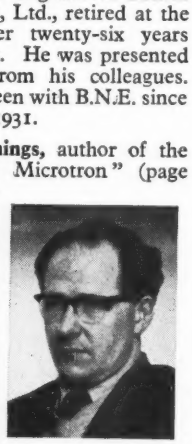
Mr. S. R. Donaldson

Mr. R. R. Walker, Post Office Telephones manager, Belfast, has been appointed telephone manager, Manchester.

The Wayne Kerr Laboratories, Ltd., announce the appointment of **Mr. L. J. Saywood** as sales engineer. Mr. Saywood was formerly a senior engineer in the Export Division of Marconi Instruments, Ltd.

Mr. G. E. Graves, sales representative in North West England for British National Electrics, Ltd., retired at the end of July after twenty-six years with the company. He was presented with a cheque from his colleagues. Mr. Graves had been with B.N.E. since it was founded in 1931.

Dr. R. E. Jennings, author of the article on "The Microtron" (page 309), was educated at King's College, London, where he received first class honours in a Special Physics B.Sc. examination. He obtained his Ph.D. in 1950. Dr. Jennings joined the Admiralty Signals Establishment in 1941 as a temporary experimental officer. After the war he became an assistant lecturer at University College, London, and in 1949 a lecturer there. He has been carrying out research work on high energy electron physics.



Dr. R. E. Jennings

The finals of the **Electrical Industries National Golf Competition** are to be held at the Bramhall and Stockport Golf Clubs on 30th September. Particulars and entry forms can be obtained from any area secretary or Mr. Frank Farthing, 22, Regent Hill, Western Road, Brighton, 1. The annual dinner is to be held at the Midland Hotel, Manchester, on the same evening when the chair will be taken by Viscount Chandos. Tickets (27s 6d each) are obtainable from Mr. J. K. Dean, Metropolitan-Vickers Electrical Co., Ltd., Ship Canal House, King Street, Manchester.

The annual dinner of the **Institution of Production Engineers** will be held at the Dorchester Hotel, London, on Friday, 4th October. The principal guest will be Sir John Maud, G.C.B., C.B.E., Permanent Secretary, Ministry of Power.

OBITUARY

Mr. William Stansfield, who served with Lancashire Dynamo & Crypto, Ltd., for nearly fifty years, died at his home at St. Annes-on-Sea on 13th August. He was eighty years of age. Mr. Stansfield was responsible for much original work in electrical engineering in the early part of this century. One of his developments was a d.c. train lighting generator giving constant voltage over a wide range of combined speed and load variation. He was instrumental in pioneering and designing the synchronous induction motor first introduced in this country in 1910, and other work included the application of two-speed s.c.r. motors for power station boiler house fans; closed-air-circuit machines with self-contained air cooler; and continuously reversing s.c.r. motors for steelworks duty and other arduous drives.

Mr. Stansfield joined the Lancashire Dynamo & Motor Co., Ltd., in 1900 and subsequently became chief estimator and then designer and assistant to the late Mr. R. S. McLeod (then chief engineer). Later he was chief electrical designer until his retirement in 1948.

Dr. Irving Langmuir.—The death occurred at Falmouth, Massachusetts, last week of Dr. Irving Langmuir, the eminent American physicist and chemist, who was associated with the American General Electric Co. for over forty years. Dr. Langmuir was born in New York and was educated at the Columbia School of Mines and at Göttingen University, Germany, graduating Ph.D. in 1906. After a brief period of teaching he joined the American G.E. in 1909 and was later responsible for many important advances in electrical equipment. Probably his most outstanding work was in connection with the gasfilled tungsten lamp. He also carried out fundamental research on oil films, atomic hydrogen welding, electric discharge equipment and high-vacuum pumps.

Dr. Langmuir received many honours during his distinguished career. He was awarded a Nobel Prize in Chemistry, the Faraday Medal (1944), Hughes Medal (1918) of the Royal Society, of which he was a fellow, and a number of doctorates from universities including Oxford and Edinburgh. He was president of the American Association for the Advancement of Science in 1941.

Mr. John Charlton, works manager of Messrs. Adamson Green & Co., Ltd., Felling, Co. Durham, has died at his home at Gateshead. He was fifty-six.

Mr. R. A. S. Boyton, O.B.E., M.I.E.E.—The death has occurred at the age of seventy-two of Mr. Robert Alexander Stewart Boyton, of Convoy House, Convoy, Co. Donegal. In the 1914-18 war Mr. Boyton was an inspecting officer at the Royal Arsenal at Woolwich and he later held the post of inspector to the Imperial Munitions Board of Canada in Ottawa before being seconded to the United States for inspection duties in Washington. He was general manager of the Antrim Electrical Supply Co. when he retired from business in 1947.

Mr. H. S. Loebl.—The death occurred at his home at Apsley, near Andover, on 13th August of Mr. Henry Samuel Loebl, who was a director of Laurence, Scott & Electromotors, Ltd., and Berry's Electric, Ltd.

WILLS

Mr. L. Howles, C.B.E., chairman of South Wales Electricity Board, who died on 13th May, left £24,283 gross (£24,016 net value).

Mr. R. A. McCulloch, M.I.E.E., manager, Salisbury District, Southern Electricity Board, who died on 5th June, left £5,170 gross (£5,055 net value).

Mr. W. Geddes, formerly works engineer to W. T. Glover & Co., Ltd., who died on 2nd May, left £11,824 gross (£11,676 net value).

Mr. W. H. Wickham, A.M.I.C.E., A.M.I.E.E., of Ealing, W., who died on 24th April, left £103,011 gross (£102,803 net).

PRICES OF MATERIALS

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £212 15s 0d
Fire Refined 99·80%	ton £211 0s 0d
Fire Refined 99·50%	ton £210 0s 0d
COPPER Tubes ..	lb 2s 0⅜d
Sheet	ton £239 5s 0d
H.C. wire and strip ..	ton £261 15s 0d
LEAD, English ..	ton £93 15s 0d
Foreign	ton £92 0s 0d
MERCURY	flask £87 0s 0d
TIN, block (English) ..	ton £745 0s 0d
ZINC, G.O.B. Foreign	ton £76 10s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 1s 8½d
Sheet	ton —
Wire	lb 2s 5½d
PHOSPHOR BRONZE Wire	lb 3s 9½d
PLATINUM	oz £31 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 27⅛—27¼d

INDUSTRIAL NEWS

Restrictive Trading Agreements

The *Board of Trade Journal* of 16th August contains a long list of commodities which are subject to agreements submitted to the Registrar of Restrictive Trade Agreements. Against each item, many of which are electrical, is given the file number. The list is published to give guidance to those who wish to inspect the Register, which they may do for a fee of 1s per day between the hours of 10 a.m. and 4.30 p.m. on any week-day except Saturday and certain holidays. The Register is available for inspection at the Registrar's offices at Chancery House, Chancery Lane, London, W.C.2, and 9, Wemyss Place, Edinburgh, 3, or at Chichester House, 64, Chichester Street, Belfast. The indexes may also be seen at these addresses.

Anglo-Norwegian Atomic Agreement

The United Kingdom Atomic Energy Authority and the Norwegian Institute for Atomic Energy have recently signed an agreement for co-operation in connection with the Norwegian Halden reactor project. This agreement is the result of the discussions mentioned in the exchange of Notes between the United Kingdom and Norwegian Governments which has been published as a White Paper (Cmd. 245, H.M. Stationery Office).

This project is concerned with an experimental reactor, scheduled to start operation early in 1958, which is designed to produce process steam suitable for wood-pulp mills and other industrial uses. The Authority has undertaken to supply the initial charge of uranium fuel elements for the reactor. The Institute and the Authority will also co-operate in a research programme with a view to developing suitable fuel elements for later charges for the reactor. The agreement provides for the Authority to have access to the reactor design and to the operating experience obtained from this important experiment.

American "Package" Reactor

The U.S. Army "package power reactor" at Fort Belvoir, near Washington, is said to have successfully completed a 700-hour performance test stipulated by the United States Atomic Energy Commission. This 2 MW pressurised-water plant was built for the American Army by ALCO Products, Inc., of New York. The Atomic Energy Commission has stated that this was the first fixed price guaranteed performance contract for a complete nuclear power plant.

The reactor is the prototype for nuclear plants of up to 20 MW being marketed outside the American continent by Humphreys & Glasgow, Ltd., London. With European manufacturing costs and a recent reduction in the cost of re-processing fuel elements, the company estimates that a 10 MW plant of this type would generate electricity at between 1d and 1½d/kWh.

Traction Equipment Orders

Crompton Parkinson, Ltd., have received an order for eighteen more electric traction equipments under the British Railways Modernisation Plan. These are for Type "B" 1,160 h.p. diesel-electric locomotives for freight and passenger services which are to be built by the Birmingham Railway Carriage & Wagon Co., Ltd., with engines by Sulzer Bros., Ltd. The equipments include main and auxiliary generators, four traction motors, four auxiliary machines for driving compressors, exhausters, fans, pumps, etc., and the electric control equipment.

The British Thomson-Houston Co., Ltd., has just received a further order for ten diesel-electric power equipments for Type "B" locomotives of 1,160 h.p. Manufacture of the first order for 20 equipments of identical type is already well advanced. The B.T.H. traction generator will be driven by a Sulzer 6 LDA 28 engine and the locomotive will be powered by four B.T.H. traction motors. The mechanical parts of the locomotives will be built in British Railways workshops. These locomotives will be used for mixed traffic duty and will be suitable for a maximum speed of 75 m.p.h.

Nickel Disposal

The Board of Trade has made an agreement with the Mond Nickel Co., Ltd., under which the latter will offer for sale, as agents of the Board, 1,600 tons of nickel pellets from the strategic reserves held by the Board. Sales will be made for consumption in the United Kingdom at the Mond Nickel Co.'s normal selling price and will, as far as possible, be spread over the period September, 1957, to June, 1958, inclusive. The Mond Nickel Co. will offer 500 tons for distribution in the near future.

Contract Price Formulæ

The British Electrical and Allied Manufacturers' Association has issued the figures for its contract price adjustment formulæ. In each case the rate of pay for adult male labour at 16th August is deemed to be 186s 6d.

The "costs of materials" figures are: For electrical machinery and equipment the Board of Trade index figure published on 16th August is 177·7. For turbo-generating and allied plant: Materials used in mechanical engineering industries 180·1, blast furnaces and iron and steel melting and rolling (40 and 41), 177·9. The price of ¾in o/d 18 s.w.g. brass condenser tubes (*Metal Bulletin*, 16th August) is 44⅜d per lb.

Electrical Work at Middlesbrough

The North Eastern Electricity Board has informed the Middlesbrough Town Council that, owing to a shortage of electricians, it will not be able to carry out the electrical wiring of new houses on the Easterside housing project. The Board has also intimated that, for similar reasons, it cannot undertake maintenance and electrical work at other Council property. In future the Council is to employ contractors to carry out the work.

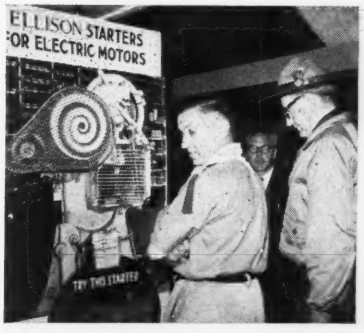
Brussels Exhibition

In a leaderette in this issue we refer to the electrical display being organised under the auspices of the B.E.A.M.A. at next year's Brussels Exhibition. The Birmingham Exchange and Engineering Centre has also announced its intention of running a group stand at the exhibition in which over 40 concerns (including some electrical companies) are participating.

Models in Electrical Development

Some of the many uses to which models are put in the cause of electrical development are indicated in a display by the Electrical Development Association at the Model Engineer Exhibition (New Horticultural Hall, London, 21st to 31st August).

Factory planning plays an important part in industrial engineering and the development of the electrical load.



During the World Scout Jubilee Jamboree held in Sutton Coldfield Park, near Birmingham, from 1st to 12th August, the chief Scout, Lord Rowallan (right) paid a visit to the special industrial exhibition staged within the Camp and is seen here inspecting electrical switchgear on the stand of George Ellison, Ltd. A brochure "Scouting and Industry" was specially prepared by the company for the Jamboree

Two types of model which the Association uses to explain these principles in its industrial films and at exhibitions are being displayed. One of these is in mass produced castings in light alloy and the other is hand-made to a larger scale. A model of school desks is used to demonstrate correct lighting in schoolrooms and six models of agricultural installations are shown.

Sometimes electrical apparatus is too small for purposes of explanation at an exhibition and to show it to better advantage models are often made. As an example of this, a model of a standard fused plug and socket enlarged to about three times its actual size is displayed.

Finally, there are three models which the Association's exhibition department have produced for their stands. These serve to show the projected scheme to those who have to approve designs and also enable the designer to work out his colour schemes and other details.

Boiler Plant for Basrah

Following the announcement of the placing of a contract with the Metropolitan-Vickers Electrical Co., Ltd., for the supply of three turbo-generating units for Basrah, Iraq, it is now reported that Babcock & Wilcox, Ltd., have been awarded the £520,000 contract for three boiler units. Ten companies competed for the order, which went to Babcock's on the basis of the best and lowest offer.

"Underground" Poster Exhibition

A poster exhibition at Charing Cross Underground station features the last tube railway to be built across central London—the Hampstead Tube—which celebrated its 50th anniversary this summer. The show will be open until 7th September.

To-day Londoners are awaiting their first new tube link for half a century—the Victoria Line—and the exhibition takes up this theme of "then and now." Surrounded by thirty original posters which were once displayed on the Hampstead Tube, are large-scale maps of the present Underground system, showing the route of the proposed Victoria Line.

Convectors

Mention of the Siemens Ediswan "Wafer" convector heaters was unfortunately omitted from the survey published in our 26th July issue, but the following description covers the range in brief.

The "Wafer" heater is principally designed for wall mounting and is only 3in thick giving a 1½in air gap between the heater and the wall. The height is 24in for all models. The exceptional robust construction of these heaters makes them especially suited to locations where durability with a neat appearance is essential.

Of the 12 types available, which include 500, 750 and 1,500 W models, the most popular are listed in the accompanying table.

Siemens Ediswan "Wafer" Convector Heaters

		List	Purchase Tax
D.121L	1 kW without switch... ...	£7 7s 0d	£3 4s 8d
D.122S	1 kW with on/off switch ...	£8 3s 0d	£3 11s 7d
D.122L	2 kW without switch... ...	£9 10s 0d	£4 3s 6d
D.122H	2 kW with 3 heat switch ...	£11 2s 0d	£4 17s 7d

Generating Plant for South Africa

Against strong Continental competition the Metropolitan - Vickers Electrical Export Co., Ltd., has received an order from the Electricity Supply Commission of South Africa for two 60 MW turbo-generator sets and associated condensers and feed water heating equipment. The equipment is for a new extension to Umgeni station, north-west of Durban. The first generating set is scheduled for delivery in February, 1960, and the second a year later.

The turbo-generators will be manufactured at Trafford Park, and the feed water heating equipment at the Metropolitan-Vickers Germiston Works, Glasgow; the steam condensers will be to Metropolitan-Vickers design, the condenser shells being made in South Africa. The turbines will be conventional two-cylinder machines, with inlet steam at 600 lb/sq in 850 deg F. A feature of the generators will be direct air cooling of the rotors; air will be circulated by integral fans through the slotted copper windings.

Technical Workers' Claim Refused

The Industrial Disputes Tribunal has turned down a claim by the Association of Scientific Workers for a percentage increase in the salaries of scientific and technical workers in the engineering industry. Members of the Engineering and Allied Employers' National Federation had already offered and put into operation a scale of flat rate increases ranging from 11s to 13s a week.

Transformer Manufacture

The Express Winding Co. has now completed its move from Mitcham to 44-46, Beddington Lane, Croydon, where increased floor area and the latest type of machinery and test equipment have enabled the company to expand its output of air-cooled transformers and rectifier power packs. A large portion of the works is devoted to the manufacture of transformers on "C" and "E" cores, while grain oriented laminations are being used to a greater extent on shell type transformers. A special department is devoted to prototype work, where modern methods enable intricate work to be carried out at low cost. A speciality is the manufacture of transformers for the use of low voltage tools and lighting and for low voltage soldering irons. Chokes and reactors are also made. A separate department deals with the manufacture of remote control panels, distribution boards and fuse boards to meet individual requirements. Wiring of customers' own equipment is also undertaken.

Rubber and Thermoplastic Cable Contracts

In an endeavour to secure stability of prices the Rubber and Thermoplastic Cable Manufacturers' Association has introduced new conditions of contract, operating from 12th August. Prices to be quoted will be those ruling at the date of tender and will apply to dispatches made within four months; after that the prices ruling at the date of dispatch will be charged.

Plant for Pakistan

Messrs. Rizvi Brothers, Ltd., Chartered Bank Chambers, Macleod Road, Karachi, 2, tell us that they are desirous of obtaining sole agencies in Pakistan for distribution transformers, generating sets (including diesel sets) and heavy switchgear. Their managing director, Mr. Z. A. Rizvi, is in London from 19th August to 5th September at Mount Royal Hotel, Marble Arch, W.1 (Mayfair 8040).

All-Electric Flats for Belfast

The Belfast Corporation Housing Committee on 14th August decided to go ahead with the building of a block of all-electric flats. These flats will be the first of their kind in Northern Ireland. The decision was taken on the recommendation of Mr. R. P. Watson, city electrical engineer, who reported on a recent visit he made to the all-electric multi-storey flats in Kirkcaldy, Scotland.

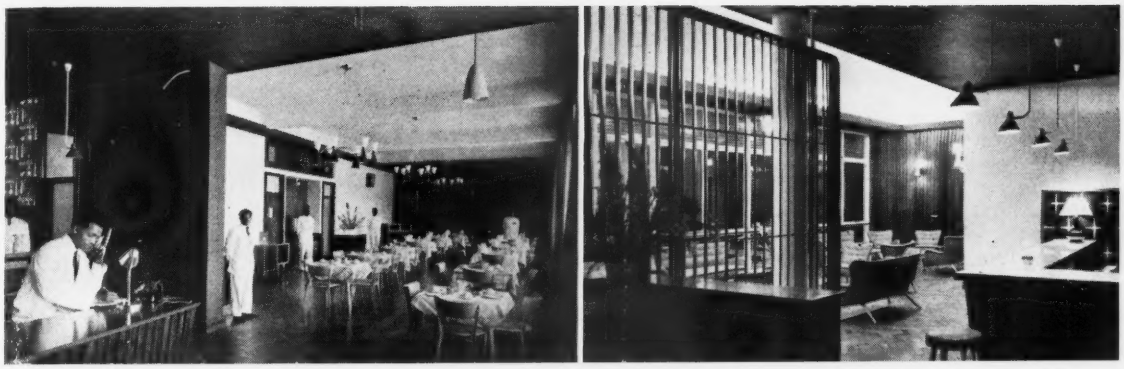
A report issued later by the Housing Committee said that one reason for bringing forward this proposal was the greater potential consumption of electricity which is expected to occur when the atomic power station for Northern Ireland is built. On the question of costs, the report stated that for a three-bedroom flat the initial cost of providing the necessary equipment would be about £176. The average running costs for all purposes, including light, would be about 19s 4d a week.

Metrovick Plant for Tankers

The Metropolitan-Vickers Electrical Co., Ltd., is to supply the geared steam turbine propelling machinery for nine large tankers ordered by the British Oil Shipping Co., Ltd., from the Furness Shipbuilding Co., Ltd. The tankers, which will be completed by 1964, range from 25,500 to 40,000 tons.

Scottish Firm's Diamond Jubilee

This year Oliver Melville & Co., Kirkcaldy, celebrate the diamond jubilee of the business founded in 1897 by the late Mr. Oliver Melville. At that time the work consisted almost wholly of supplying and maintaining generators and other industrial equipment. Over the years the scope has extended to cover electrical contracting (the firm is a member of the E.C.A. of Scotland), the sale of domestic



The modern railway station recently completed at Nakuru, Kenya, is the first of its kind in East Africa. The lighting fittings were supplied by Troughton & Young (Lighting), Ltd., through their agents in Nairobi, the Anglo-Baltic Corporation, Ltd. The ring pendants and wall brackets in the restaurant are part of the "Mondolite" range, with specially coloured reflectors. Over the reception desk there are specially modified "Versalite" fittings

equipment and repair work, and now a furniture department has been opened.

To accommodate this new department the premises have been substantially extended. The principals of the firm are Mr. J. Y. Dick and Mr. J. M. Melville, a son of the founder of the firm.

Capacitor Trouble in America

Last week the New York correspondent of the *Daily Telegraph* reported that because of chemical contamination of the oil filling, half a million capacitors for fluorescent lamps became troublesome in service. In a number of cases, it was said, the result was overheating which caused the bursting of the containers.

The manufacturers, the American General Electric, say that steps were immediately taken to replace faulty capacitors without charge and to inspect all lighting systems into which they might have found their way. The trouble has now been practically overcome and steps have been taken to prevent any recurrence.

Electric Diecasting Furnace

In describing the Morgan-Birlec type E.D.F. furnace in our issue of 2nd August (page 217) we regret that an error occurred in the illustrations. The electric diecasting furnace was shown in the right-hand photograph while that on the left was the Morgan Basin tilting crucible furnace, Type BT Mk II, which is complementary to the diecasting furnace.

Garcke's Manual

The 1956-57 edition of "Garcke's Manual of Electricity Supply," which has just been published, is in similar form to previous editions. The general survey of the electricity supply industry includes a section on nuclear power development which gives particulars of the revised programme of nuclear power generation announced by the Government in March last. The constitution and functions of the United Kingdom Atomic Energy Authority are outlined, and particulars of the constitution, organisation and generating stations of the C.E.A. are given and of the functions of the Area Electricity Boards. A separate section is devoted to the North of Scotland Hydro-Electric Board and the South of Scotland Electricity Board, and undertakings in Ireland, the Isle of Man, the Channel Islands, etc. Details are also given of manufacturers of electrical plant, and the directory sections include lists of associations and institutions and executive personnel. The Manual is available from the Electrical Press, Ltd., 19-20, Noel Street, London, W.1, price £3 17s 6d net.

Accumulator Makers' Association

The address of the Accumulator Makers' Association is now 77, Bedford Court Mansions, Bedford Avenue, London, W.C.1 (telephone: Museum 8976).

Trade Announcements

The Dictaphone Co., Ltd., Acton, has taken over the sales, distribution and servicing of its "Time-Master" dictating machines in Belgium and has opened a branch office at 4, Rue du Finistère, Boulevard Adolphe Max, Brussels. This is the company's first Continental branch.

George Kent, Ltd., announce that in view of the expansion of business their organisation in Belgium has recently been converted into a separate company under the title of Kent Continental S.A. This new company, which has its headquarters at 82, Chaussée de Charleroi, Brussels, comprises a sales, engineering and service organisation covering the full range of Kent products, with a well-equipped workshop.

Truvox, Ltd., announce that they are increasing their sales organisation covering industrial floor treatment machines throughout Great Britain and Mr. J. Gladstone has been appointed area manager for the Midlands and South West. The company's representatives in this area will be as follows:—Mr. J. W. Kirk, 59, Goldsmith Street, Nottingham (Derby, Notts., Lincs. and Rutland). Mr. P. W. L. Vicary, 26, Oughton Road, Sparkbrook, Birmingham (Leics., Warwicks., excluding Birmingham, and Northants). Mr. M. J. Stokes, 63, Pitcairn Road, Warley Woods, Birmingham, 41 (Birmingham, Salop, Staffs. and Worcs.). Mr. G. Kempton, Joywin, Blackhorse Road, Mangotsfield, nr. Bristol (Cornwall, Devon, Dorset, Somerset, Glos., Wilts., part of South Wales up to and including Cardigan and Radnor, and Hereford).

Taylor-Short & Mason, Ltd., have formed a new subsidiary which revives the original name of Short & Mason, Ltd., to handle its scientific and meteorological instrument business. The main company, which has been renamed Taylor Controls, Ltd., will continue to handle all industrial instrument and control business. **Short & Mason, Ltd.**, are moving to a newly acquired factory at Aneroid Works, 280, Wood Street, Walthamstow, London, E.17 (Coppermill 2203/4). **Taylor Controls, Ltd.**, remain at 75, Hale End Road, Walthamstow, London, E.17 (renamed Forest Works) (telephone: Larkswood 3371/6).

Lindsay & Williams, Ltd., Ashton Old Road, Manchester, 11, manufacturers of "Megohmoid" insulating tape, inform us that they have recently installed a Telex machine, the number being 66269. Their telegraphic address has also been altered to "Megohm, Telex, Manchester."

Fielden Electronics, Ltd., is opening a new North Eastern sales and service office at Stockton-on-Tees on 5th September. The branch is under the management of Mr. K. Hymer.

Changes of Name

The name of Installations (Radio), Ltd., has been changed to Ulster Radio & Television Services, Ltd.

Meech Electric Drives, Ltd., has changed its name to Burdette-Meech, Ltd.

Continuous Stress-Relief of Transformer Laminations

FOR some years it has been standard practice, after stamping transformer laminations, to stress-relieve the sheet in a lift-off furnace. One of the requirements in the manufacture of these stampings is a high space factor: buckling and "rivelling" of the edges of the sheet are bound to make a bulky transformer. The lift-off furnace has normally been used for the heat treatment since it allows the careful placing of packs of laminations which are then left undisturbed throughout the heating cycle.

As soon as the process is considered carefully, it becomes clear that the lift-off furnace has several serious disadvantages. The first and most obvious, of course, is that it is a batch method. It is also clear that considerable difficulty is experienced when loading the furnace. The stampings vary considerably in size, and production methods are such that there is very seldom a furnace load of one size of stamping. Great skill and care are necessary to fit the greatest number of stampings on the furnace base, while allowing good heat transfer to the load, and avoiding distortion of the stampings.

Even if production methods were such as to give a large number of the same size sheets at the same time, it would be undesirable to have an unbroken stack of stampings reaching the full piling height of the furnace: heating up and cooling would be extremely slow. Moreover, this cannot be overcome by increasing the heating rate which gives rise to serious distortion of the sheet. This is because the heat is transferred through the edges of the packs: thus the edges reach soaking temperature while the centre is still relatively cold. Severe strains are set up which result in wavy edges and, in extreme cases, buckling of the whole sheet. It is worth noting that the adoption of a slow heating and cooling cycle does not completely cure this trouble. In practice, steel spacer pieces are placed every six to eight inches to separate the packs and allow heat transfer vertically as well as by edge heating. The next pack is then supported on a steel plate to reduce distortion. Thus a considerable weight of steel is uneconomically heated in each cycle. The complete soaking of the stampings, the spacer pieces, and the furnace cover requires a 45-50 hr cycle.

This length of cycle introduces a further difficulty. Carbon is an undesirable impurity in electrical sheet, and the manufacturer aims at reducing it to a very low level: certainly below 0·008 per cent. Such sheet is highly susceptible to carbon pick-up during heat treatment. The atmosphere must therefore be non-carburising especially since the sheet is in contact with the atmosphere for a long period. For this reason an atmosphere derived from cracked and burned ammonia—not the cheapest of atmospheres—is required for a lift-off furnace.

Metalectric Furnaces, Ltd., Smethwick, who have built a considerable number of lift-off furnaces, were led to the conclusion that the continuous furnace might well have many advantages in its favour.

Several advantages seemed possible: a very great reduction in the time cycle; a cheaper form of atmosphere could be used, because the shorter heating time would bring a great reduction in the risk of carbon pick-up; a much better flow of work would be possible because a continuous furnace could be designed to suit the maximum width of sheet, while variations in length, so awkward in the batch method, would be unimportant; and a considerable fuel saving was likely because there would be no spacer pieces and steel plate to heat up.

Accordingly Metalectric engineers carried out a series of tests on a continuous furnace arranged to use any industrial controlled atmosphere. In this way it was possible to compare the effect of various atmospheres on the physical and electrical properties of the sheet. By arrangement with one of the leading manufacturers of electrical equipment, matched pairs of test pieces were cut from sheet: one test piece in each pair was stress-relieved by the manufacturer's usual method; the other was heat treated in a continuous furnace. The samples were then tested and compared.

The results showed conclusively that the long-cycle lift-off process was unnecessary. The continuously treated test pieces were in physical condition much better than those from the batch process. In electrical tests there was less difference; nevertheless, there was still a slight advantage in favour of the continuous process. The mean losses in watts per lb of a large number of the batch treated samples were 0·539, 0·536 and 0·542 whilst the continuous furnace gave 0·523, 0·527 and 0·526. The mean of these figures is 0·539 for the batch and 0·525 for the continuous process.

The next step clearly was to stress-relieve sufficient

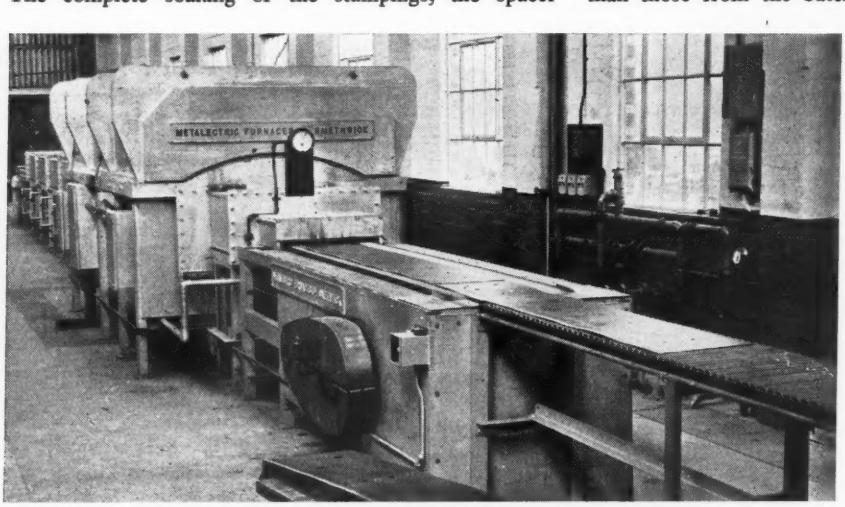


Fig. 1.—Charge end of Metalectric continuous stress relieving furnace at the Rugby works of the British Thomson-Houston Co., Ltd.

stampings to build a complete transformer. This was necessary to prove the method, and also to show that the higher heating and cooling rates obtainable in the continuous process have no deleterious effects on the laminations whether from the physical or from the electrical standpoint. The experiment was completely successful, an important point being that the laminations were completely flat, while the atmosphere used was only one-fifth the cost of the cracked and burned ammonia.

Metalectric Furnaces have now built or are building a large number of continuous furnaces for this work, with outputs ranging from 20 to 60 tons per week. Experience gained on these plants has shown that while the total cost of stress-relieving in lift-off furnaces varies between £8 and £10 per ton, in the continuous furnace the cost is £5 10s to £7 10s per ton—a very substantial saving.

A typical furnace for this work is shown in the illustration (Fig. 1). It is installed at the works of the British Thomson-Houston Co., Ltd., Rugby. The overall length of the furnace is 60ft, and the heating sections have two separately controlled zones. The nickel-chromium tape elements are fitted to the sides and hearth of the chamber, and are rated at 120 kW. Although the normal working temperature is 820 deg C the furnace is designed to operate at up to 900 deg C. The cooling section is water-jacketed and is mounted on rollers to allow for expansion. The conveyor is 26in wide to handle laminations up to 24in wide. It is driven by a variable speed gear: the usual belt speed is 1ft per minute giving a complete cycle from charge to discharge of one hour, compared with the 40 hours or more of the batch process. Output at this speed is 450-500 lb per hour.

The laminations are loaded directly on to the conveyor in shallow packs; there is thus a much greater heat transfer rate in this furnace than obtains in the lift-off furnace with its thicker packs. The laminations travel through an inlet canopy designed to reduce controlled atmosphere losses, then through a vestibule which acts as a heat seal, and so through the regulated heat and soak zone, through the cooling zone and the outlet canopy on to a roller conveyor. Power consumption in this furnace is only 15·2 kWh/cwt of work processed, i.e. 304 kWh/ton. The protective atmosphere is supplied by an incandescent "Hi-nitrogen" plant producing 1,000 cu ft of nitrogen per hour (Fig. 2). Air is inspirated and mixed with sufficient fuel (in this case town's gas) to give complete combustion and thus remove the free oxygen in the air. The products of combustion are then bubbled through monoethanolamine which absorbs the carbon-dioxide and the remaining gas is passed through a dryer which removes the water vapour, leaving dry nitrogen. In normal operation, a dewpoint of −30 deg F is consistently obtained; lower dewpoints can be obtained if necessary.

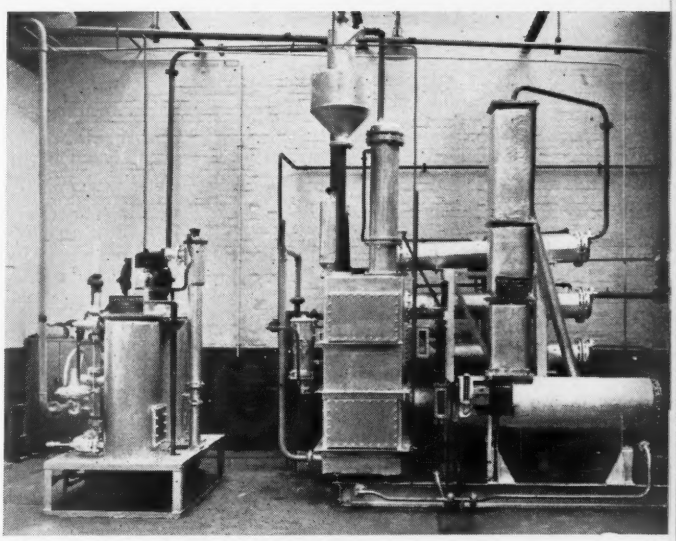


Fig. 2.—1,000 cu ft/hr "Hi-nitrogen" plant

Electrical Research Reports

ONE of the recently issued research reports of the British Electrical and Allied Industries Research Association, Ref. Q/T143, "Electromagnetic Forces in Transformers with Multi-Layer Windings," by M. Waters, B.Sc., M.I.E.E. (price 12s 6d), gives methods for calculating the reactance and the electromagnetic forces in transformers of the multi-layer type. The effect of sub-dividing the outer winding into discrete layers is taken into account and also the progressive shortening of the layers which is required in this type of construction. Three cases are considered: (1) Windings with complete ampere-turn balance; (2) inner winding extending to the middle of the taper in the outer winding; (3) inner winding with the same overall length as the tapered outer winding.

The radial field produced by ampere-turn asymmetry in a transformer with concentric windings is affected by the core proportions. The spacing between limbs is relatively unimportant, but the ratio of leg length to core circle diameter is found to have an appreciable effect. In Ref. Q/T144, "The Effect of Core Proportions on Axial Electromagnetic Forces in Transformers with Concentric Windings," by M. Waters (price 6s) previous work in Ref. Q/T134 is extended so that this ratio may be taken into account when calculating axial electromagnetic forces or increased reactance due to the radial flux.

The development of measurement circuits for the E.R.A. network analyser necessitated the production of an amplifier of very low phase shift and stable gain. Ref. V/T120, "A Stable Decade Amplifier for the Frequency Range 10 c/s to 1 Mc/s," by D. C. G. Smith, B.Sc., A.Inst.P. (price 10s 6d), describes the design and performance of an amplifier which fulfils the required conditions and whose gain is stabilised at a value of 10 ±0·1 for the frequency range 10 c/s to 1 Mc/s. A discussion of possible applications of the amplifier is included.

Model Construction

In Ref. L/T359, "Models of Materials with Loss per Cycle nearly independent of Frequency," by H. Pelzer (price 10s 6d) ladder type structures are constructed, based on a continued fraction expansion of the logarithmic function, which exhibit either approximately, or over a limited range of frequencies, a loss behaviour that is often encountered in high polymers not only in the dielectric

behaviour but also in rheology, viz. a loss per cycle that is independent of frequency down to extremely low frequencies. Although such formal models have in general no direct bearing on the actual mechanism, in the present case one of them seems to suggest a molecular model in which groups of molecules are cross-linked into spindle-shaped aggregates and immersed in the viscous liquid constituted by the remaining molecules.

Interference by H.V. Lines

High-voltage distribution lines operating at voltages in excess of 11 kV, and in particular those operating at 132 kV, have not proved serious sources of interference in the United Kingdom. Isolated cases of severe interference have been experienced both in the long- and medium-wave broadcast bands and in the television band, but they have been confined to installations in premises very close to or immediately beneath the line.

Reports of interference studies on higher voltage lines on the Continent and in the U.S.A. have raised doubts concerning the degree of interference which might be expected from the use of higher voltage lines in the United Kingdom. Work on a short section of experimental line has been carried out, but no evidence of the conditions which might apply to normal operation of long sections of line is yet available.

As a preliminary to making a study of the interference from the higher voltage lines when they come into operation the Association has carried out a series of measurements on existing 132 kV and 33 kV lines over a period of about one year. Ref. M/T122, "Radio Interference from High-Voltage Distribution Systems," by S. F. Pearce, B.Sc., A.Inst.P. (price 10s 6d), summarises the results of these tests.

Copies of the above reports are available at the prices indicated from the British Electrical and Allied Industries Research Association, Thorncroft Manor, Dorking Road, Leatherhead, Surrey.

FRENCH RAILWAY ELECTRIFICATION

ELECTRIFICATION is again the main feature in the new five-year plan for the further modernisation and re-equipment of the French Railways. In view of the success of the 25 kV 50 c/s system it is being adopted for all future electrification schemes, other than extensions to the existing 1,500 V d.c. system.

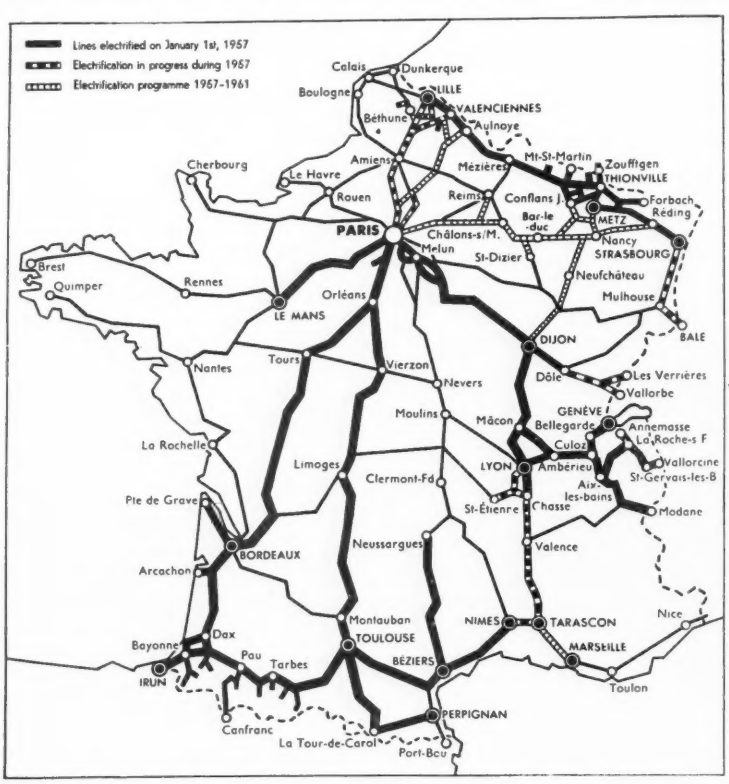
During 1957 the electrification of the lines between Strasbourg and Bâle, Dole and Vallorbe and Frasne-Pontarlier will be completed. The Nord-Paris scheme, which includes the Paris-Lille line and various branch lines to Valenciennes and the principal coalfields, will be completed by the end of 1958. Conversion to electric traction of the 300 miles of line covered by this scheme will save 400,000 tons of coal per annum.

Extensions of the 1,500 V d.c. electrification south of Lyons to St. Etienne and Valence are due for completion in 1958, with the sections Valence-Avignon and Avignon-Nîmes to follow in 1959 and 1960 respectively.

Further electrification projects to be undertaken under the third stage of the five-year plan and covering over 900 miles of line, with an estimated economy of 1,200,000 tons of coal per annum, are as follows:—Commencing 1957: the Paris-Châlons-Sarrebourg line with branches from Epernay to Reims, from Blesme to St-Dizier, from Lérouville and Nancy to Metz, and from Toul to Neufchâteau and eventually Dijon. Commencing 1958: the lines between Creil and Aulnoye and between Busigny and Somain, to provide a direct link between Paris and the Belgian frontier, and the mines at Aniche and Anzin; and the suburban lines of the Eastern Region, from Paris to Meaux and of the Northern Region, from Paris to Mitry and to Orry-la-Ville.

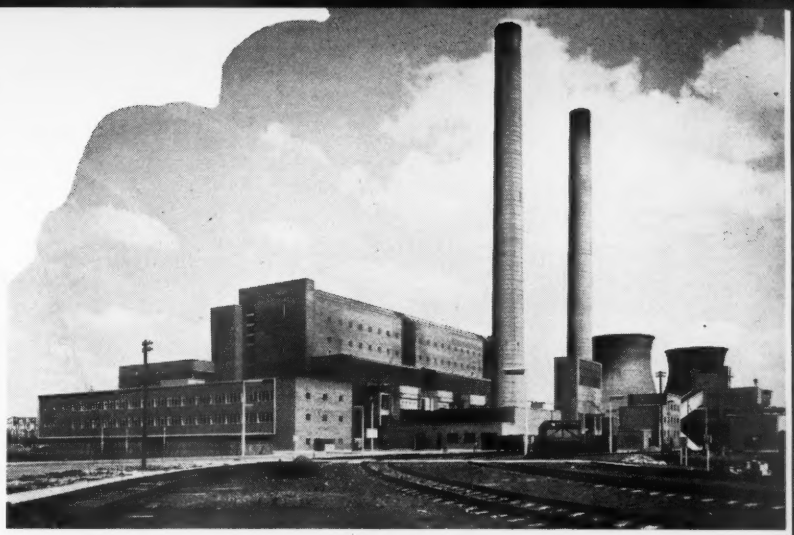
The five-year plan also provides for the extension from Tarascon to Marseille of the electrification of the Paris-Lyon-Tarascon-Nîmes line.

When this programme is completed, the electrified lines of the French Railways will total nearly 5,000 miles (approximately 20 per cent of the whole system). They will carry 70 per cent of the total traffic against 40 per cent at present. The annual consumption of electricity for traction purposes will then be 3,500 million kWh.



Map of the French Railways system showing lines to be electrified

GOLDINGTON POWER STATION



OFFICIAL INAUGURATION OF 150 MW PLANT

ALTHOUGH the first of six 30 MW sets in the Goldington power station just outside the town of Bedford was put into commission in 1955 and the fifth in May last, the official inauguration of the plant took place only last week when the ceremony was performed by Major Simon Whitbread, Lord Lieutenant of Bedfordshire.

Originally planned by the Bedford Corporation, Goldington became the responsibility of the British Electricity Authority in 1948. Initial consent was obtained in 1950, preliminary work on the site began in 1951 and construction in the following year. Now five sets are in operation and the sixth is being installed for commissioning early next year, thus completing the 180 MW plant. The station is unremarkable in general, but may be regarded as a good example of what may be called the " bread and butter " type of C.E.A. station.

The buildings are erected on a reinforced concrete raft on piles driven into the gravel subsoil. Steel framework clad in rustic brick is employed in the construction of the power station. To match this the two 325ft chimneys and the five cooling towers (165ft high, 155ft diameter base) are in coloured reinforced concrete.

Coal is delivered by road or rail. In the latter case the wagons are handled by two tipplers. Underground twin belts and bucket conveyors take the coal to the 550 ton boiler bunkers. Alternatively, the coal goes to an 88,000 ton coal store from which it is reclaimed by a 125 tons/hr drag-line scraper. From the bunkers the coal passes through weighers to the pulverising mills (three per boiler).

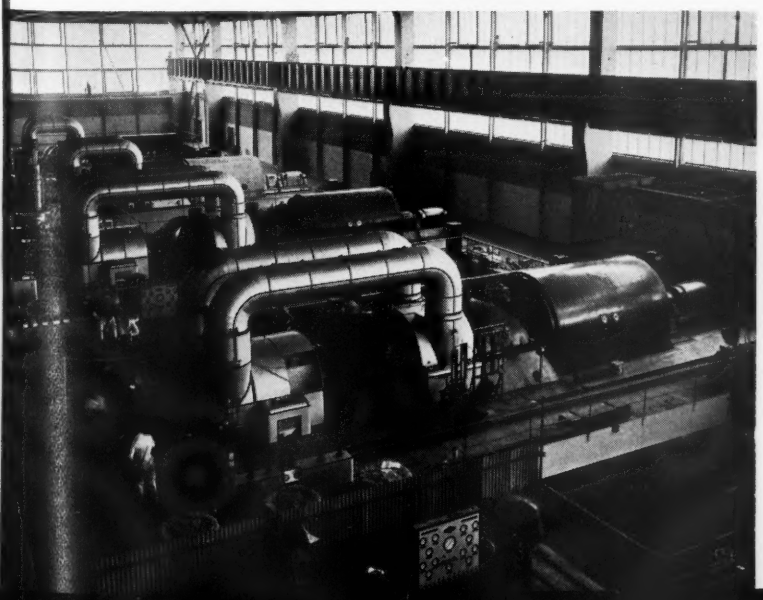
Each boiler has an evaporative capacity of 300,000 lb/hr at m.c.r. Steam conditions at the stop valve are 625 lb/sq in and 865 deg F. The heating surface, including water walls, is 11,870 sq ft.

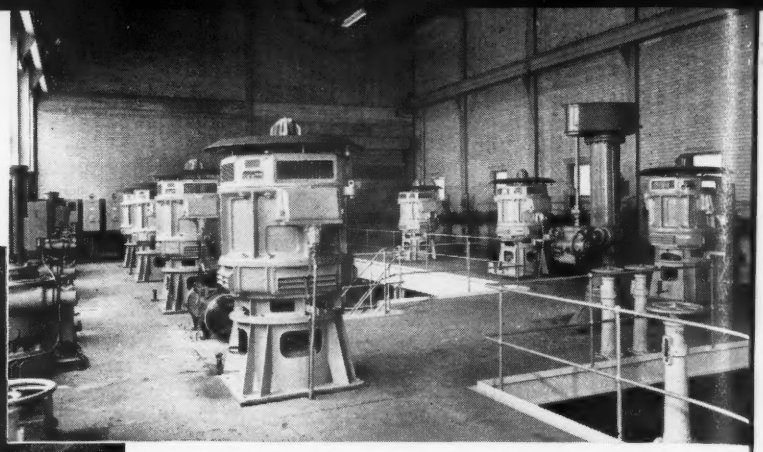
Three " Lopulco " burners are fitted at each corner of the boilers and steam temperature control is maintained by varying the angle of the burners. Air for combustion is drawn from the top of the boiler house by two forced draught fans and is preheated in a regenerative air heater, then passing to the combustion chamber through the pulverising mills. There are also air inlets adjacent to the burners. For lighting-up purposes there are six electrically ignited oil burners. These also come into operation automatically whenever the coal fire shows signs of instability.

After passing through an economiser (17,820 sq ft) and air heater (72,000 sq ft) the gases are treated by mechanical extractors and then go through electrostatic precipitators to the chimney exit. The " Melesco " self-draining superheater (11,410 sq ft) is arranged to form high- and low-temperature sections in the gas path and a single steam flow across the width of the unit. Fully automatic control of boiler output is maintained by co-ordinated adjustment of the fuel and air supply to the furnace in relation to the steam pressure at the superheater outlet.

For boiler water conditioning an injection pump feeds chemicals direct to the boiler drum. Provision is also made for injecting chemicals directly to the economiser inlet to protect the economiser. The drum water level is controlled under varying load by a " Flowmatic " regulator. Water for the boiler and evaporator feeds is treated by

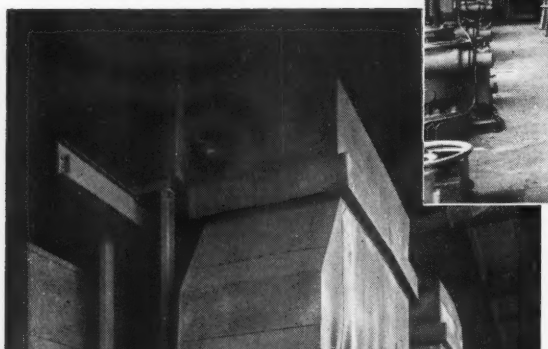
Title picture shows exterior of the station, the main buildings, cooling towers and coal-handling plant and shown below are the 30 MW 11·8 kV turbo-generators





Right: Circulating water pumps

Below: Air preheaters



chemical plant combining a hydrogen-ion blend process, a hydrogen-ion and acid absorption process, with degasifier, and a mixed-bed demineralisation plant. The plant is in two sections, each capable of supplying 5,000 gal/hr of softened or completely treated water.

Two 100 per cent duty feed pumps are provided for each boiler/turbine unit. Cooling water is supplied jointly from the adjacent River Ouse or from the cooling towers. Under average conditions the river provides sufficient water for one set. A reinforced concrete open channel forms the river inlet culvert and the cooling tower outlets are connected to the channel which carries the water to the six 22,000 gal/min pumps. Water leaving the condensers and auxiliary coolers passes into a common culvert from which it is pumped to the cooling towers by pumps similar to the circulating water pumps.

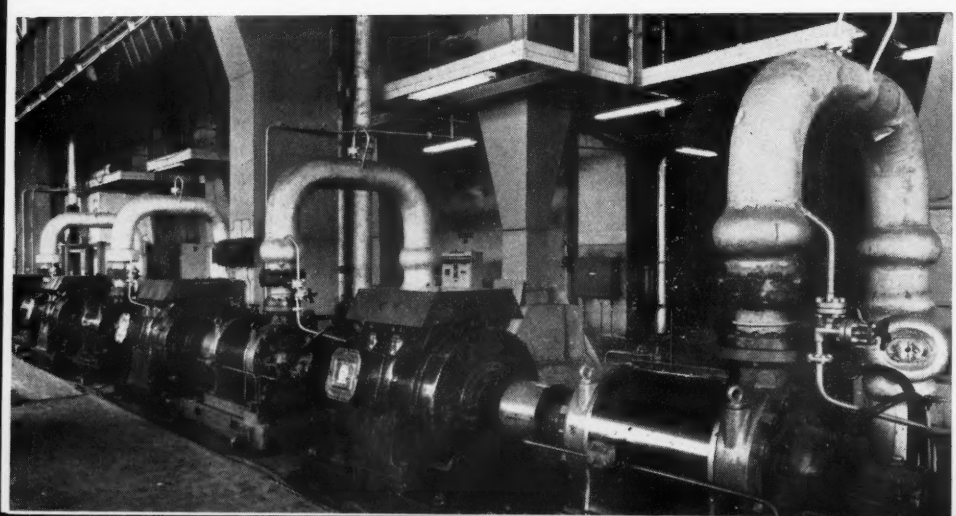
From the water-filled furnace hoppers ash is sluiced by high-pressure jets to a settling pit behind the station and transferred from there by grabs to road lorries. Dust from the hoppers of the flue gas cleaning plant is removed pneumatically to a bunker at the rear of the boiler house and taken away by lorry.

The 3,000 r.p.m. turbines are of the impulse type with the low-pressure section exhausting to twin three-pass condensers. They are designed for steam at 600 lb/sq in at 850 deg F with vacuum at m.c.r. of 28·5in Hg. There are four stages of feed heating, one l.p. and three h.p., giving a final feed temperature of 340 deg C. Each boiler and turbine combination operates as a unit; there is no interconnection on either steam or feed systems. A vacuum-operated device on each machine reduces turbine load automatically if the condenser vacuum falls. Bursting discs are fitted on the l.p. cylinders to prevent the machines and condensers being subject to a build-up of pressure in the condenser.

Mechanical turbine and emergency governors operating an oil relay system are fitted. Motor barring gear is provided for operation during shut-down and starting periods. There are three 50 per cent capacity lubricating oil coolers on each set and each set has a motor-driven centrifugal oil purifier. An automatic electro-mechanical device is fitted to operate if a tube in any of the h.p. heaters bursts; this causes the feed water to by-pass the heaters. Two main three-stage steam-operated air ejectors are installed and there is also a quick-start ejector for the initial raising of vacuum. Two 100 per cent vertical spindle motor-driven extraction pumps are situated at basement level near the condenser. Each surface type condensing plant (27,000 sq ft) consists of two shells connected in parallel and directly coupled to the double-flow l.p. turbine exhaust flange.

The 30 MW (0·8 power factor) 11·8 kV alternators feed directly to generator transformers stepping up the output to 132 kV. They are fan cooled, the air coolers being situated in the foundation blocks. Cooling water is taken from the circulating water system.

The 36 MVA generator transformers are situated in a compound in front of the turbine house. Each has two 50 per cent coolers of the forced oil/air-blast type and is fitted with on-load tap-changing equipment. The main 132 kV air-blast switchgear situated in the same compound has a rupturing capacity of 2,500 MVA.



Left: Boiler feed pumps

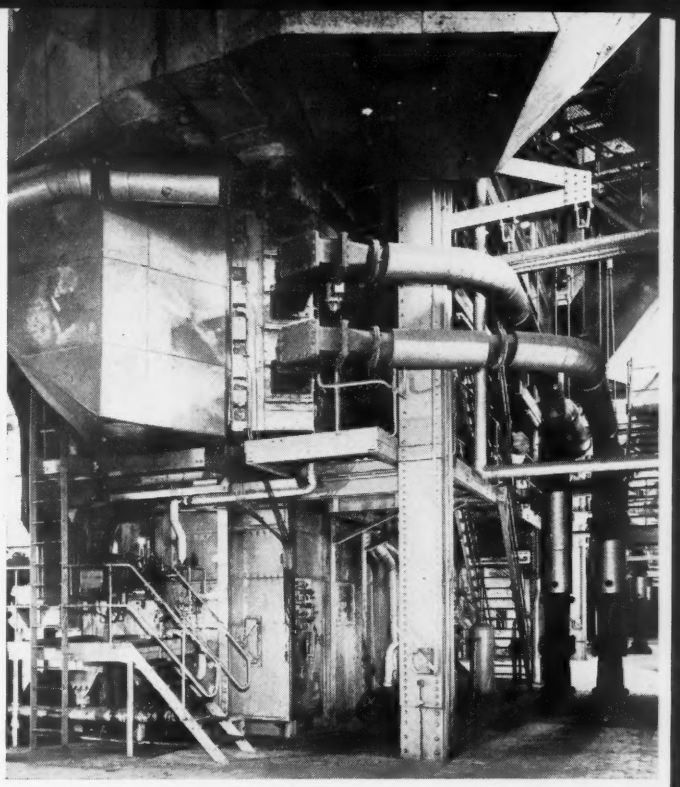
Essential supplies for the boiler/turbine units are drawn from unit transformers directly connected to the alternators. Auxiliary transformers are situated at the side of the turbine house facing the switching compound. All station supplies and power for non-essential auxiliaries are obtained from 5 MVA 132/3·3 kV station transformers. The 3·3 kV and 415 V switchgear is in annexes adjoining the turbine and boiler houses. Although most of the cabling is p.i.l.c. a considerable amount of mineral-insulated copper-clad cable has been used in the boiler house.

The central control room dealing with generator output, station electrical services and outgoing feeders is situated in the administration block. Plant control rooms, one for each pair of boiler/turbine units, are arranged between the boilers and turbines at operating floor level. These contain all the equipment necessary for the operation of the boilers and turbines and, except in unusual circumstances, the plant is effectively controlled from these rooms.

Goldington station is in the Eastern Division of the Central Electricity Authority of which Mr. W. N. C. Clinch, M.I.E.E., is controller. The station was constructed under the supervision of Mr. T. Yule, M.Eng., M.I.C.E., M.I.Mech.E., A.M.I.E.E., and the station superintendent is Mr. R. R. Belbin. Messrs. Merz & McLellan are the main consulting engineers; the associated civil consultants are Sir Alexander Gibb & Partners, who are also responsible for the architectural treatment.

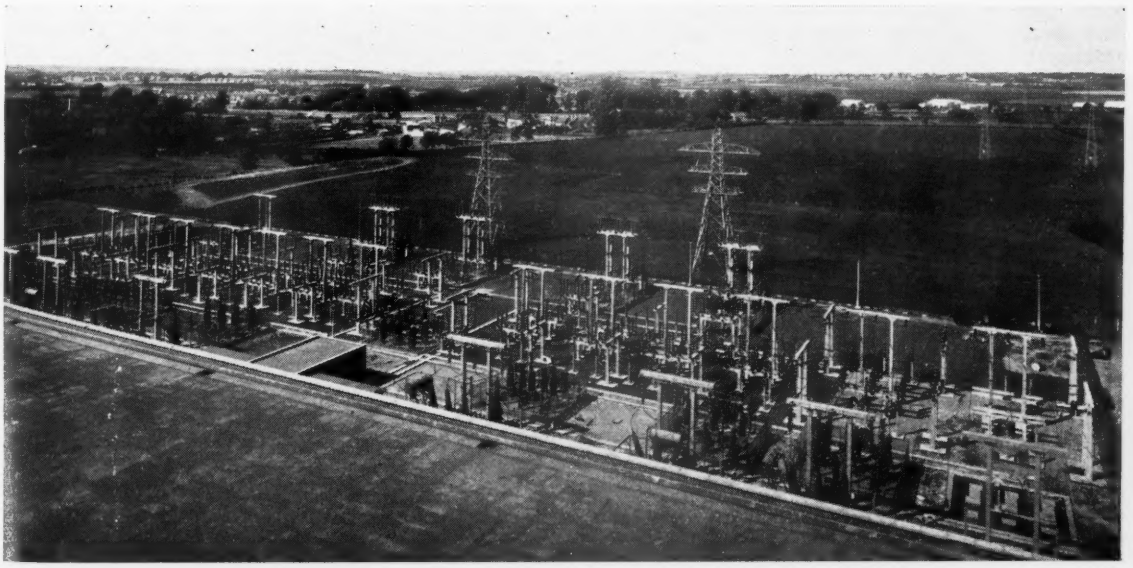
The following are the principal contractors:—

Taylor Woodrow Construction, Ltd., access roads; Mitchell Construction Co., foundations and superstructure; John Booth & Sons (Bolton), Ltd., structural steelwork; Film Cooling Towers (1925), Ltd., cooling towers; Bierrum & Partners, Ltd., chimneys; W. H. Allen, Sons & Co., Ltd., circulating water and boosting pumps; William E. Farrer, Ltd., circulating water penstocks and screens; J. Blakeborough & Sons, Ltd., valves; Clarke, Chapman & Co., Ltd., boiler plant; Electroflo Meters Co., Ltd., instrumentation and automatic boiler control; British Thomson-Houston Co., Ltd., turbo-alternators; G. & J. Weir, Ltd., condensing and feed-heating plant; Clyde Crane & Engineering Co., turbine house crane; Wharton Crane & Hoist Co., Ltd., and Herbert Morris, Ltd., auxiliary cranes; Mather & Platt, Ltd., boiler feed pumps; International Combustion, Ltd., coal handling plant; B.V.C. Industrial Constructions, Ltd., ash and dust handling plant; Stewarts & Lloyds, Ltd., h.p. and l.p. pipework; Hopkinsons, Ltd., and Dewrance & Co., Ltd., h.p. valves and mountings; Sir W. H. Bailey & Co., Ltd., l.p. valves; Paterson Engineering Co., Ltd., chlorinating plant; Andrew Barclay, Sons & Co., Ltd., shunting locomotives; Permutit Co., Ltd., water treatment plant; Sturtevant Engineering Co., Ltd., electrostatic precipitators and vacuum cleaning plant; Hackbridge & Hewittic Electric Co., Ltd., generator and station transformers; Bonar Long & Co., Ltd., auxiliary transformers; A. Reyrolle & Co., Ltd., 3·3 kV and 415 V switchgear; Chloride Batteries, Ltd., station batteries and charging equipment; Malcolm & Allan (London), Ltd., 11 kV and lower voltage cables; Walter Kidde Co., Ltd., CO_2 fire-fighting equipment; London Electricity Board, main lighting and heating installation; Rashleigh Phipps & Co., Ltd., lighting and plug point installation, control block and 132 kV switching station; Troughton & Young, Ltd., site lighting; Mather & Platt, Ltd., water jet fire-fighting and alarm installation.



View of the boiler house

The 132 kV switching station at Goldington



NEWS FROM SOUTH AFRICA

FROM OUR CORRESPONDENT

THE installation in rural areas of automatic power stations, electronically controlled, is envisaged in plans prepared for a small municipality in the Eastern Cape. Should the scheme be carried out it will be the first fully automatic power plant in the world designed on electronic principles for use as an unattended station. The Johannesburg engineer responsible for developing the system is Mr. Arnold L. Owen. He said that the electronic control had been developed in conjunction with the South African branch of a leading firm of electronic engineers. "It has been possible in the past to make power plants automatic in operation within certain limits, but the cost was usually prohibitive for small installations. By adopting electronic control, the equipment necessary for complete automation has been cheapened considerably. What is more important is that it has been made more compact and does not include any delicate mechanisms. This makes it eminently suitable for installation in remote areas where supervision is normally difficult and in some cases impossible."

The development of this invention may well solve South Africa's problem of getting power supplies into those areas where the demand cannot justify expensive transmission lines from central generating stations. The new method of automatic control can also be installed in major power stations where it would simplify the problems of supervision. This could lead to the employment of less skilled staff than is at present necessary and could release highly trained men for other work.

Shortage of Skilled Staff

Except for a serious shortage of manpower, the Electricity Supply Commission is managing to cope with the problem of supplying power to most of the Union, said Mr. I. de Villiers in his presidential address to the Institute of Electrical Engineers in Johannesburg. The shortage of skilled and experienced staff had become a serious problem in the post-war development of Escom, and it was one which, unfortunately, was becoming worse. Escom had designed and built five of the eight new power stations constructed since the last war. The remaining three were built by contractors. In 1946 the Commission employed 794 Europeans and 1,836 non-Europeans; last year the figures were 4,514 and 7,976 respectively. By extending existing power stations up to their ultimate capacities, no new stations would be needed until about 1961.

The Minister of Economic Affairs said recently that the Board of Trade and Industries had been asked by the Government to advise it on subsidising rural electrification schemes. The intention was not to subsidise individual farmers but to promote collective schemes. He said that Government policy would be to do as much as possible to provide rural electrification for the ordinary farmer. The Government was co-operating very closely with the South African Agricultural Union, which had now established a central committee to go into this question. The time was yet distant when electricity would be used on South African farms for the variety of tasks it performed in other countries.

There is a growing feeling in the Cape that atomic power may be closer than many people think. A Government commission is inquiring into the question at present. It was appointed in January this year to consider "the desirability of establishing a nuclear power station or stations in the Western Cape and other areas remote from the country's large coalfields." One of the factors likely to influence the Government is the increasing difficulty of transporting enough coal owing to the limited capacity of the railways.

Railway Improvements

The South African Railways report that they are importing some £566,400 worth of 3,000 V traction equipment, which is to be installed in ten substations, each of which will have a capacity of 6,000 kW. Five of these substations are being built in Natal in connection with the doubling of the main line to Johannesburg. The substations are being designed to take a primary supply at 88 kV from the Electricity Supply Commission. The remaining five substations are in the Transvaal.

A comprehensive programme of improvements and additions to electric lighting and power facilities on the South African Railways is being undertaken. This provides for the modernisation of the distribution systems serving stations, workshops, marshalling yards and harbour areas, and the installation of electric lighting in station buildings. Major improvements include a new 11 kV distribution system in the Cape Town area; the uprating of the 6·6 kV distribution system serving harbour and workshops in the East London area to 11 kV; a new 11 kV distribution system to serve the workshops and station area at Bloemfontein; augmentation of power supplies to mechanical workshops at Durban; and provision of power supplies to the new Johannesburg station.

Considerable progress has been made with the electrification programme. At the moment work in hand includes electrification of the double line between Boughton and Umbulwana and of the sections from Rossburgh to Cato Ridge (via Pinetown), Welverdiend to Klerksdorp, Midway to Vereeniging, and Pretoria inter-urban area. Plans have now been completed for the electrification of the Wattles-Kroonstad, Apex-Rangeview-Dunswart, Springs-Natalspruit, and Witbank-Welgedag sections. It is expected that the Broodsnyersplaas-Oogies section will also be electrified.

New Power Stations

The Pretoria City Council has decided to apply to the Union Treasury and the Transvaal Administrator for borrowing powers for £9,580,000. The money will be used for the construction of the first stage of a new power station at Rooiwal, near Pretoria, and for extensions to the electricity distribution system. It is estimated that the new power station will cost about £14 million. A report from a British firm of consulting engineers states that the continued growth of the power load in Pretoria will necessitate building a new plant. Nuclear power, it says, does not offer a possible alternative to the conventional type of power station, nor would it be possible to build a nuclear power station in the available time.

The first series of tenders for the £9,250,000 extension to the Kelvin power station in Johannesburg are at present being scrutinised by the City Engineer's Department. The initial contracts are expected to involve an expenditure of over £6,500,000. An announcement will probably be made in September.

CABLE RATINGS

Cyclic Rating Factor Calculation for Cables Laid Direct or in Ducts

By H. GOLDENBERG, M.Sc.*

THE maximum permissible currents (current ratings) for British Standard cables are based on the continued application of a constant a.c. or d.c. current. As the maximum load is usually applied only for a limited time, an increase in current rating is permissible, such increases being given by cyclic rating factors. Owing to the mathematical complexity of the formulæ involved, the range of cyclic rating factors available until recently has been rather limited,[1, 2, 3] although relevant formulæ have been well known,[2, 3, 4, 5] as has been the use of an analogue computer for making the necessary calculations for any load cycles.[6]

The contribution of an A.I.E.E. working group on the subject of cyclic loading of pipe-type cables and buried lead sheathed cables has been given in four recent papers.[7, 8, 9, 10] The first of these covers mainly ground common to the remaining three, while each of the latter recommends a different procedure, the difference between the final results being negligible in view of the uncertainties regarding the thermal constants involved.[11] Only rectangular and sinusoidal loss cycles are covered[8, 9] by methods appropriate for routine application, complicated loss cycles being treated by tedious superposition methods.[8, 10, 5]

This article is based on a recent I.E.E. paper,[12] and describes a new, simple and rapid method for the calculation of cyclic rating factors which may be applied without difficulty even in the case of very complex load curves.

The effect of the thermal capacity of the cable itself is assumed to be negligible, as is usually the case, although a formula has been presented[12] showing how this factor may be taken into account if desired with little consequent increase in the amount of calculation. The cyclic rating factors of the present article are therefore slightly on the safe side.

Transient Heating of Buried Cable

The transient core temperature rise $\theta_c(T)$ of a cable at a sufficiently large time T hours after the application of a step function load for the effect of the thermal capacity of the cable to be negligible, is given by[2, 3]:—

$$\frac{\theta_c(T)}{\theta_c(\infty)} = 1 - k + k\alpha(T) \quad .. \quad .. \quad .. \quad .. \quad (1)$$

where k is the ratio of outer cable temperature rise to core temperature rise, under steady conditions, and $\alpha(T)$ the ratio of transient outer cable temperature rise to steady state outer cable temperature rise. Various formulæ for $\alpha(T)$ have been presented, each based on different idealisations of the heat flow problem, and on the assumption that the surface of the ground is an isothermal.

When the cable is considered as replaced by a continuous line source of heat at the cable centre, with a constant rate of heat liberation per unit time per unit length of the source, and when the cable is also assumed to possess the same thermal properties as the soil in which it is buried, the resultant formula for $\alpha(t)$ is readily obtainable from expressions given by Buller[4] or Carslaw and Jaeger,[14] and is:—

$$\alpha(t) = \frac{-\mathrm{Ei}\left(-\frac{d^2}{16Dt}\right) + \mathrm{Ei}\left(-\frac{e^2}{Dt}\right)}{\log_e(16e^2/d^2)} \quad .. \quad .. \quad (2)$$

where—

t = time, seconds.
d = outside diameter of the cable, cm.
e = depth of the axis of the cable below the ground surface, cm.
D = thermal diffusivity of the soil, cm^2/sec.
Thermal diffusivity = 1/(thermal resistivity × density × specific heat).

The expression $-\mathrm{Ei}(-x)$ is the exponential integral function defined by—

$$-\mathrm{Ei}(-x) = \int_x^\infty \frac{e^{-u}}{u}\,du$$

Excellent tables of the exponential integral function have been published by the National Bureau of Standards.[15] Whitehead and Hutchings[2, 3] obtain an expression for $\alpha(T)$ for a continuous cylindrical surface source by integrating the effects of identical continuous line sources around a circle coinciding with the cable diameter. Their expression is obtained after approximations dependent on the depth of laying of the cable being much greater than the cable radius, and is—

$$\alpha(t) = \frac{-\mathrm{Ei}\left(-\frac{d^2}{8Dt}\right) + \left(\log_e 2\right)\exp\left(-\frac{d^2}{8Dt}\right) + \mathrm{Ei}\left(-\frac{e^2}{Dt}\right)}{\log_e(16e^2/d^2)} \quad ..(3)$$

This formula has been used as a basis for the present work, but for the range of values of the parameters involved the percentage difference between the values of $\alpha(t)$ given by the formulæ (2) and (3) is quite small, even for the most unfavourable cases.[12]

Calculating Cyclic Rating Factors

The heat dissipated in a cable may with sufficient accuracy for the present purposes be taken as directly proportional to the square of the applied current. Denoting the magnitudes of the appropriate hourly rectangular pulses into which the square of the daily cyclic load is decomposed by $Y_0, Y_1, \ldots Y_{23}$, where each of the Y's is expressed as a fraction of their maximum value, it may be shown that[12] the cyclic load as a whole may be multiplied by the following cyclic rating factor for the same permissible core temperature rise:—

$$\text{Cyclic Rating Factor} = \frac{1}{\sqrt{(1-k)Y_0 + kA}} \quad .. \quad (4)$$

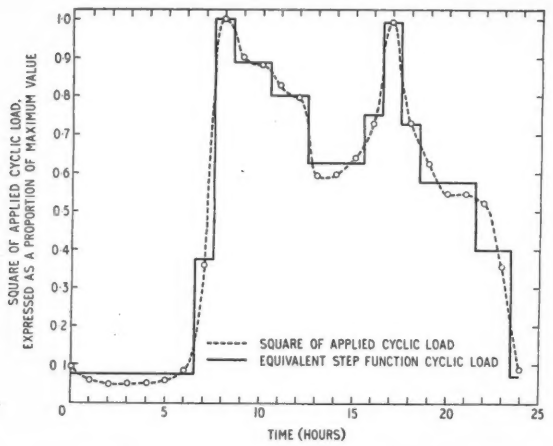
where—

$$A = Y_0 Q_0 + Y_1 Q_1 + \ldots + Y_{23} Q_{23}$$

$$Q_r = \sum_{m=0}^{\infty} \left\{ \alpha(r + 1 + 24m) - \alpha(r + 24m) \right\}$$

Calculated values of Q_r for $r = 0(1)23$, and for cable

* Electrical Research Association.


SQUARE OF APPLIED CYCLIC LOAD, EXPRESSED AS A PROPORTION OF MAXIMUM VALUE
TIME (HOURS)
SQUARE OF APPLIED CYCLIC LOAD
EQUIVALENT STEP FUNCTION CYCLIC LOAD

diameters of 0·5 (0·25) 4·5, 5·0, 6·0 inches and depth of laying 3 feet are given in Table 1 for soil thermal diffusivity of 0·01 cm²/sec (and in Ref. 12 for soil thermal diffusivity of 0·02 cm²/sec). The values of Q_r are referred to below as Q factors. The range of cable diameters includes those of all cables covered by B.S. 480 : 1954, and has been extended to 6 inches to permit utilisation for cables in ducts. No appreciable error is involved in assuming Table 1 to be valid for other depths of cable burial.

Safe cyclic rating factors for cables in ducts will be obtained on the assumption that, for the purposes of equation (1), the inner wall of the duct is taken as the outer diameter of an equivalent cable, the duct material having a thermal resistivity not materially different from that of the majority of British soils.

Factor k and Environment

The evaluation of a cyclic rating factor for any particular cable and applied cyclic load requires the numerical evaluation of k, the ratio of outer cable temperature rise to core temperature rise under steady load. With negligible dielectric loss or otherwise k may be found from the formula $k = \frac{PG_e}{\theta_c}$ where θ_c is the core temperature rise for the cable working at a current giving losses P watts/cm length of cable, and G_e is the cable external thermal resistance/cm in that condition. A non-dimensional graph enabling G_e to be readily evaluated for a single multi-core cable or for three single-core cables in trefoil touching formation has been included in Ref. 12.

Values of k have been calculated for representative areas for all voltages for cables conforming with the latest British Standard[13] and are given in detail in Table 2 for cables laid direct and in Ref. 12 for cables in ducts, relevant assumed depths of laying being given at the foot of the tables. These values may be used directly where applicable. They are based on a soil thermal resistivity of 120 deg C cm/watt, a protective covering thermal resistivity of 500 deg C cm/watt, and a dielectric thermal resistivity of 750 deg C cm/watt for 1·1 kV cables and 550 deg C cm/watt for higher voltage cables up to and including 33 kV. These calculated values of k may readily be adjusted to correspond to any different soil thermal resistivity g deg C cm/watt. If k(g) denotes the value of k for a soil thermal resistivity of g deg C cm/watt, then it may be shown that:—

$$k(g) = \frac{1}{1 + \frac{120}{g}\left[1 - k(120)\right]} \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

This enables k to be calculated for any value of g in terms of the given tabulated values k(120).

Numerical Example

The cyclic load chosen for illustration purposes is based on that given[16] as the National Load for 1st December, 1947. The load is assumed to be at constant voltage and power factor, so that variation of load represents variation of current. As indicated above we are directly concerned only with (current)² expressed as a proportion of its peak value, and this ratio is plotted in the figure (dotted lines) together with an equivalent load curve of rectangular steps. Numerical values of the rectangular steps are given in Table 3. It should be noted that the two curves have approximately the same mean value, while the number of rectangular steps chosen has deliberately been reduced from a possible maximum of 24 to facilitate subsequent calculation. All equivalent curve crests are considered as persisting for at least one hour. In cases when the time of maximum temperature is not obvious it may be necessary

TABLE 1
VALUES OF Q FOR SOIL THERMAL DIFFUSIVITY 0·01 CM²/SEC

r	Cable Diameter or Inner Duct Diameter in inches																			r
	0·50	0·75	1·00	1·25	1·50	1·75	2·00	2·25	2·50	2·75	3·00	3·25	3·50	3·75	4·00	4·25	4·50	5·00	6·00	
0	0·480	0·441	0·409	0·381	0·357	0·335	0·316	0·297	0·279	0·263	0·248	0·234	0·220	0·208	0·196	0·185	0·174	0·153	0·119	0
1	0·073	0·079	0·083	0·087	0·090	0·093	0·096	0·098	0·100	0·102	0·103	0·104	0·105	0·106	0·107	0·107	0·108	0·108	0·107	1
2	0·048	0·051	0·054	0·057	0·059	0·061	0·063	0·064	0·066	0·067	0·068	0·070	0·071	0·072	0·073	0·073	0·074	0·076	0·077	2
3	0·037	0·040	0·042	0·044	0·046	0·048	0·049	0·050	0·052	0·053	0·054	0·055	0·056	0·057	0·057	0·058	0·059	0·060	0·063	3
4	0·031	0·034	0·036	0·037	0·039	0·040	0·041	0·042	0·043	0·044	0·045	0·046	0·047	0·048	0·048	0·049	0·050	0·051	0·054	4
5	0·027	0·029	0·031	0·033	0·034	0·035	0·036	0·037	0·038	0·039	0·040	0·041	0·041	0·042	0·043	0·044	0·044	0·045	0·048	5
6	0·025	0·027	0·028	0·029	0·030	0·032	0·033	0·034	0·034	0·035	0·036	0·037	0·038	0·038	0·039	0·039	0·040	0·041	0·043	6
7	0·023	0·025	0·026	0·027	0·028	0·029	0·030	0·031	0·032	0·033	0·033	0·034	0·035	0·035	0·036	0·036	0·037	0·038	0·040	7
8	0·021	0·023	0·024	0·025	0·026	0·027	0·028	0·029	0·030	0·030	0·031	0·032	0·032	0·033	0·033	0·034	0·034	0·035	0·037	8
9	0·020	0·022	0·023	0·024	0·025	0·026	0·026	0·027	0·028	0·029	0·029	0·030	0·030	0·031	0·031	0·032	0·033	0·033	0·035	9
10	0·019	0·020	0·022	0·023	0·024	0·024	0·025	0·026	0·026	0·027	0·028	0·028	0·029	0·029	0·030	0·030	0·031	0·032	0·033	10
11	0·018	0·020	0·021	0·022	0·022	0·023	0·024	0·025	0·025	0·026	0·026	0·027	0·027	0·028	0·028	0·029	0·029	0·030	0·032	11
12	0·017	0·019	0·020	0·021	0·022	0·022	0·023	0·024	0·024	0·025	0·025	0·026	0·026	0·027	0·027	0·028	0·028	0·029	0·031	12
13	0·017	0·018	0·019	0·020	0·021	0·021	0·022	0·023	0·023	0·024	0·024	0·025	0·025	0·026	0·026	0·027	0·027	0·028	0·029	13
14	0·016	0·017	0·018	0·019	0·020	0·021	0·021	0·022	0·023	0·023	0·024	0·024	0·025	0·025	0·025	0·026	0·026	0·027	0·028	14
15	0·016	0·017	0·018	0·019	0·019	0·020	0·021	0·021	0·022	0·022	0·023	0·023	0·024	0·024	0·025	0·025	0·025	0·026	0·028	15
16	0·015	0·016	0·017	0·018	0·019	0·019	0·020	0·021	0·021	0·022	0·022	0·023	0·023	0·023	0·024	0·024	0·025	0·025	0·027	16
17	0·015	0·016	0·017	0·017	0·018	0·019	0·019	0·020	0·021	0·021	0·022	0·022	0·023	0·023	0·023	0·024	0·024	0·025	0·026	17
18	0·014	0·015	0·016	0·017	0·018	0·018	0·019	0·020	0·020	0·020	0·021	0·021	0·022	0·022	0·023	0·023	0·023	0·024	0·025	18
19	0·014	0·015	0·016	0·016	0·017	0·018	0·019	0·019	0·020	0·020	0·020	0·021	0·021	0·022	0·022	0·023	0·023	0·023	0·025	19
20	0·014	0·015	0·015	0·016	0·017	0·018	0·018	0·019	0·019	0·020	0·020	0·020	0·021	0·021	0·022	0·022	0·022	0·023	0·024	20
21	0·013	0·014	0·015	0·016	0·017	0·017	0·018	0·018	0·019	0·019	0·020	0·020	0·020	0·021	0·021	0·021	0·022	0·022	0·024	21
22	0·013	0·014	0·015	0·016	0·016	0·017	0·017	0·018	0·018	0·019	0·019	0·019	0·020	0·020	0·021	0·021	0·021	0·022	0·023	22
23	0·013	0·014	0·015	0·015	0·016	0·016	0·017	0·017	0·018	0·018	0·019	0·019	0·019	0·020	0·020	0·020	0·021	0·022	0·023	23

TABLE 2

CALCULATED VALUES OF k FOR REPRESENTATIVE AREAS OF CABLES CONFORMING TO B.S. 480 : 1954. CABLES LAID DIRECT IN THE GROUND. SOIL THERMAL RESISTIVITY 120 deg C cm/watt

Nominal Conductor Area sq in	Three Core Belted Armoured and Served Cables				
	1·1 kV†	3·3 kV	6·6 kV	11 kV	22 kV
*0·007	0·48	—	—	—	—
*0·0225	0·54	0·57	0·55	0·54	—
0·0225	0·57	0·60	0·58	0·57	—
0·04	0·62	0·63	0·61	0·60	0·54
0·10	0·67	0·69	0·67	0·65	0·59
0·30	0·75	0·76	0·74	0·72	0·68
0·50	0·77	0·79	0·78	0·76	—
0·75	0·79	—	—	—	—
1·00	0·81	—	—	—	—

Nominal Conductor Area sq in	Three Core Belted Unarmoured and Served Cables				
	1·1 kV†	3·3 kV	6·6 kV	11 kV	22 kV
*0·007	0·53	—	—	—	—
*0·0225	0·59	0·62	0·60	0·58	—
0·0225	0·64	0·65	0·63	0·61	—
0·04	0·67	0·69	0·66	0·64	0·57
0·10	0·73	0·74	0·72	0·70	0·63
0·30	0·80	0·80	0·78	0·76	0·69
0·50	0·81	0·83	0·81	0·79	—
0·75	0·82	—	—	—	—
1·00	0·83	—	—	—	—

Nominal Conductor Area sq in	Three Single Core Served Cables in Trefoil Touching Formation					
	1·1 kV†	3·3 kV	6·6 kV	11 kV	22 kV	33 kV
*0·007	0·71	—	—	—	—	—
*0·0225	0·77	0·78	0·75	0·73	—	—
*0·10	0·84	0·85	0·83	0·81	0·77	0·73
*0·25	0·88	0·88	0·86	0·85	0·81	0·79
*0·50	0·90	0·91	0·89	0·88	0·85	0·83
*0·75	0·90	0·92	0·91	0·90	0·87	0·85
*1·00	0·91	0·93	0·92	0·91	0·88	0·87

Nominal Conductor Area sq in	Twin Belted and Served Cables 1·1 kV	
	Armoured	Unarmoured
*0·007	0·48	0·53
0·0225	0·54	0·60
0·04	0·58	0·64
0·10	0·64	0·70
0·30	0·71	0·77
0·50	0·74	0·78
0·75	0·76	0·79
1·00	0·78	0·80

Nominal Conductor Area sq in	Three Core Screened Unarmoured and Served Cables		
	11 kV	22 kV	33 kV
0·0225	0·63	—	—
0·04	0·67	0·63	—
0·10	0·73	0·67	0·64
0·25	0·78	0·72	0·70
0·50	0·81	0·75	0·74

Nominal Conductor Area sq in	Three Core Screened Armoured and Served Cables		
	11 kV	22 kV	33 kV
0·0225	0·59	—	—
0·04	0·63	0·60	—
0·10	0·69	0·64	0·62
0·25	0·74	0·69	0·68
0·50	0·78	0·74	0·73

Nominal Conductor Area sq in	Three Core S.L. Armoured and Served Cables	
	22 kV	33 kV
0·04	0·63	—
0·10	0·68	0·65
0·30	0·74	0·72
0·50	0·77	0·76

* Circular conductors. † Depth of cable surface below ground—36 inches for all cable voltages above 1·1 kV. 25·5 inches for cable voltage = 1·1 kV. All cables have added sheath protection as specified in B.S. 480 : 1954.

to perform the calculation more than once, using each possible time of highest temperature as zero time, but in the present case this is obviously at 17·5 hours. In particular, in cases where the load falls slowly after a peak, the temperature may continue to rise for a short time after peak load.

For our example we will take an isolated circuit laid direct, with standard conditions of laying and various soil constants. The cable under consideration is one isolated circuit comprising three single-core 1·00 sq in 33 kV p.i.l.s. cables, served and with added sheath protection, conforming to B.S. 480 : 1954. The method of laying is direct in the ground in trefoil touching formation at depth 36in of upper cable axis below ground surface. The soil constants are:—soil thermal diffusivity D = 0·01 cm²/sec, and soil thermal resistivity g = 120 deg C cm/watt. The load is as described above, illustrated in the figure and tabulated in Table 3. Additional data

TABLE 3

LOAD DATA CORRESPONDING TO NATIONAL LOAD CURVE

Step Function Equivalent to (Cyclic Load per Peak Load)²	
T (Hours)	Magnitude of Step Function at Time T
0– 6·5	0·075
6·5– 7·5	0·375
7·5– 8·5	1·000
8·5–10·5	0·885
10·5–12·5	0·800
12·5–15·5	0·625
15·5–16·5	0·75
16·5–17·5	0·99
17·5–18·5	0·725
18·5–21·5	0·575
21·5–23·5	0·40
23·5–24	0·075

TABLE 4

Calculation of Cyclic Rating Factor for Example. National Load Curve of Figure applied to one Isolated Circuit comprising Three Single-Core 1·00 sq in 33 kV Cables laid direct in the Ground in Trefoil Touching Formation

(1)	(2)	(3)	(4)	(5)
Time,* Hours	Y Step Function Equivalent to (Cyclic Load per Peak Load)²	Q Factors for D=0·01 d=2·50 from Table I	Summation of (3) over Consecutive Constant Values of (2)	(2) × (4)
0–1	0·99	0·279	0·279	0·276
1–2	0·75	0·100	0·100	0·075
2–3	0·625	0·066		
3–4	0·625	0·052	0·161	0·101
4–5	0·625	0·043		
5–6	0·80	0·038		
6–7	0·80	0·034	0·072	0·058
7–8	0·885	0·032		
8–9	0·885	0·030	0·062	0·055
9–10	1·00	0·028	0·028	0·028
10–11	0·375	0·026	0·026	0·010
11–12	0·075	0·025		
12–13	0·075	0·024		
13–14	0·075	0·023		
14–15	0·075	0·023	0·159	0·012
15–16	0·075	0·022		
16–17	0·075	0·021		
17–18	0·075	0·021		
18–19	0·40	0·020		
19–20	0·40	0·019	0·039	0·016
20–21	0·575	0·019		
21–22	0·575	0·019	0·056	0·032
22–23	0·575	0·018		
23–24	0·725	0·018	0·018	0·013
			Total = A =	0·676

* Time measured prior to expected time of maximum core temperature.
Depth of upper cable axis below ground surface = 36in.
Outer diameter d of each cable of trefoil formation = 2·41in.
Soil thermal diffusivity D = 0·01 cm²/sec.
Soil thermal resistivity g = 120 deg C cm/watt.
Value of k from Table 2, k = 0·87.
Value of column (2) for time 0–1 hour = Y_0 = 0·99.

$$\text{Cyclic Rating Factor} = \frac{1}{\sqrt{(1-k)\,Y_0 + kA}} = 1{\cdot}18.$$

required are overall diameter of each cable = 2·41in (from B.S. 480 : 1954); k for this cable at above depth of burial and soil resistivity is given by k = 0·87 (from Table 2).

The method of calculation can be seen from Table 4, which may be considered as a proposed standard table in which time in hours has already been printed in column 1.

(i) Enter in column 2 the values of Y, namely, the step function equivalent to (cyclic load per peak load)^2, for the appropriate hours from Table 3, measuring time prior to the expected time of maximum core temperature.

(ii) Enter in column 3 the Q factors for D=0·01 cm^2/sec, d = 2·41in from Table 1. As no values are tabulated for exactly d = 2·41in, enter those for the nearest tabulated diameter (2·50in). The error in this procedure is negligible.

(iii) Enter in column 4 the sum of the entries of column 3 over consecutive constant values of column 2.

(iv) Enter in column 5 the product of the corresponding entries of columns 2 and 4.

(It is equally permissible to omit column 4 and enter in column 5 the products of the individual entries in columns 2 and 3, but the process adopted generally reduces the number of multiplications—in the present case from 24 to 11.)

(v) Enter at the foot of column 5 the value of A, the sum of the individual entries in column 5. Here A=0·676.

(vi) Note the value of Y_o, the entry in column 2 for time 0–1 hour. Here $Y_o = 0{\cdot}99$.

(vii) Calculate value of cyclic rating factor from equation (4), namely—

$$\text{Cyclic rating factor} = \frac{1}{\sqrt{(1-k)Y_o + kA}} = 1{\cdot}18$$

Effect of Varying Soil Constants

Calculations made for the cable and load curve of the present example for a range of soil thermal characteristics give the following cyclic rating factors:—

D \ g	60	90	120
0·01	1·16	1·17	1·18
0·02	1·13	1·14	1·15

It will be observed that the cyclic rating factors increase with increasing soil thermal resistivity and decreasing soil thermal diffusivity. The soil thermal diffusivity D and resistivity g vary substantially along the length of a cable at a given time and with time at a given point of the cable. Safe cyclic rating factors may be obtained when based on an over-estimate of the thermal diffusivity, and an under-estimate of the thermal resistivity. The diffusivity values adopted in this article are over-estimates rather than under-estimates, so that a lack of knowledge of soil thermal diffusivity appears to be no obstacle in the utilisation of the methods set out.

The work described in this article was carried out under the direction of Mr. L. Gosland, whose assistance and encouragement the author gratefully acknowledges. The author is also indebted to the Institution of Electrical Engineers for permission to reproduce information and a diagram from an I.E.E. monograph[12] on which this paper is based.

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Ionising Radiations in Industry

A NEW Code of Regulations known as Factories (Ionising Radiations) Special Regulations (Preliminary Draft) is now obtainable from H.M. Stationery Office, price 9d net. This is the first attempt to make regulations in a new and highly specialised field. Representations regarding the draft regulations should be sent to the Secretary, Ministry of Labour and National Service, 19, St. James's Square, London, S.W.1, not later than 31st October next. After these have been considered a further draft will be prepared.

The regulations are necessary because the use of ionising radiations from radioactive substances and from X-ray apparatus is rapidly increasing. Among the chief uses are X-radiography and gamma-radiography of castings, forgings and welds, the fluoroscopic examination of manufactured articles, the analysis of crystalline compounds, the elimination of static electricity, the measurement and control of thicknesses and package monitoring and tracer work. Ionising radiations produce ions (i.e. charged particles) in any matter through which they pass. Some radiations are comparatively harmless whilst others can have a very deleterious effect. Serious damage can occur by inhaling or swallowing a radioactive substance but this cannot occur when the substance is sealed in a container. This "sealed source" prevents the radioactive substance being dissipated into the air and is much safer than if it was in an unsealed or "open" source.

The present draft code deals with "sealed sources" and with ionising radiations produced by certain electrical machines and thus covers the major part of the problem arising in industry from the use of ionising radiations. The major use of "open sources" is in the luminising of dial markings on watches and instruments. This work is already covered by the Factories (Luminising) Special Regulations, 1947. But there may be an increase in the use of unsealed radioactive substances in the future and a further Code is in preparation to control these.

NEW ELECTRICAL EQUIPMENT

Photo-Cell Counting Unit

A new range of counting equipment working at speeds up to 400/min and designed for easy installation is now being manufactured by SUTTON COLDFIELD ELECTRICAL ENGINEERS, Reddicap Trading Estate, Coleshill Road, Sutton Coldfield, Warwicks. A composite unit consists of three basic units: relay unit, cell holder and light unit. In many instances the relay unit and cell holder can be combined as an integral unit to form a composite item as illustrated. All components are assembled in diecast cases finished in durable enamel.

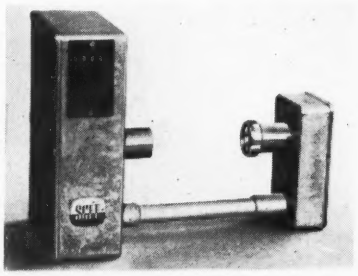


Photo-cell counting unit

Injection Moulding

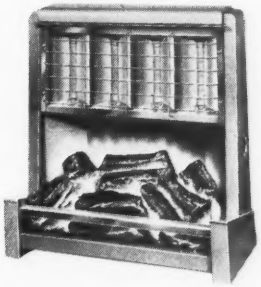
F. J. EDWARDS, LTD., 359-361, Euston Road, London, N.W.1, have recently introduced the Stübbe injection moulding machine, model H 200 VE, which is capable of moulding a 4½in diameter handwheel from unplasticised rigid p.v.c. This hydraulic injection moulder incorporates a special heating cylinder which enables articles up to 10 oz to be moulded. Special attention has also been given to the design of the metering device below the feed hopper, to ensure that only the correct quantity of material enters the injection cylinder and this, combined with exact working temperature control, enables objects of uniform structure and great strength to be produced, irrespective of the type of material used.

The machine weighs 3¼ tons and the overall dimensions are 150in long by 48in wide by 66in high. The maximum projected area of mouldings is 90 sq in, and the liquefying capacity 33-42 lb/hr. Operating at up to four injections per minute and with a piston stroke of approximately 8in, the heating element rating of the machine is 4½ kW.

Hand operated, semi-automatic and fully automatic models are available. Closing, clamping and injection are performed hydraulically and the clamping pressure is further increased by means of a toggle system. The control and instrument panel are arranged in a separate cabinet and afford safe and easy operation.

Electric Fire

An addition to the "Magicoal" range of electric fires, the "Dukesberry," has been introduced by BERRY'S ELECTRIC, LTD., Touchbutton House, Newman Street, London, W.1. The fire is finished in warm silver with polished rustless front bar and radiant heat reflectors. Heat control is by two recessed switches and the total loading is 2 kW. The fire is 21in high by 20½in wide by 8¾in deep and weighs 19½ lb. A safety guard and 6ft of 3-core flex are fitted. The price is £12 9s 6d plus £5 9s 6d purchase tax in the United Kingdom.

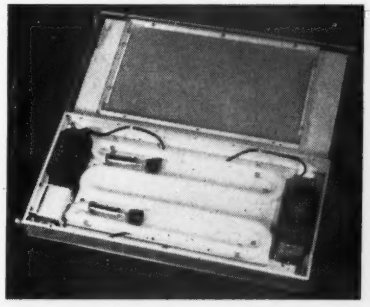


Berry's "Dukesberry" coal-effect fire

Die Press Lighting Unit

A die press lighting unit developed by the A.E.I. LAMP & LIGHTING CO., LTD., Crown House, Aldwych, London, W.C.2, for use in various types of heavy duty presses is now available to any press manufacturer on bulk order.

The unit was developed to light the die platforms of presses during the initial setting up of tools and to assist the accurate handling of material during operation. Since the lighting units are in the view of the press operator, excessive brightness has been avoided by the use of a specially made 75 W "new warm white" cold cathode fluorescent tube of 20 mm diameter, arranged as a 4-leg grid, screened by an internally reeded panel of light opal plastic. As an additional anti-shock safeguard, the lamp is mounted in the unit on a separate platform, secured to the fitting by impact resistant mountings which limit movement of the platform and safeguard the lamp from internal movement.



Mazda die press lighting unit

The unit is constructed of "Bonderised" sheet steel, finished in stoved enamel, and as a precaution against oil and grease is sealed by Neoprene gaskets. The flexible cable carrying the mains supply is also sheathed in Neoprene or p.v.c.

Induction Heaters

Grid controlled induction heaters rated at 9, 15 and 25 kW have recently been introduced by RADIO HEATERS, LTD., Eastheath Avenue, Wokingham, Berks. This equipment has both a grid controlled power supply and a built-in variable r.f. output transformer which enable the power output of the equipment to be smoothly controlled over the full power output range. The grid controlled rectifiers control the anode voltage from a third to full h.t. and the variable r.f. output transformer provides in addition to the grid control system a 20 : 1 power output variation. By reducing the maximum power output, the equipment can be made independent of mains supply variations for any desired level. These facilities are especially required for such operations as silicon zone refining, etc.

Safety pressure and flow switches cut the equipment off if the cooling water falls below a safe amount. An auto-clean filter intercepts all impurities of 0·020in and cooling air is drawn in through a filter behind the right-hand bottom panel. The power transformers and tank condenser are

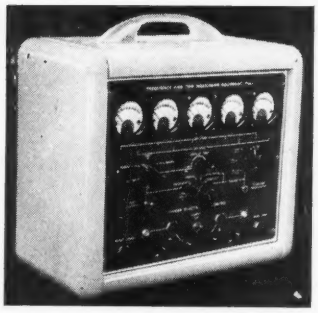
Radio Heaters' grid controlled induction heater

oil immersed. All necessary wiring for two timers is incorporated initially and the ranges available are 0-10, 0-30, 0-100 sec, 0-10 and 0-30 min.

The cubicle, which is fitted with rubber-mounted castors, is entirely constructed of hard aluminium finished in high gloss grey and black stove enamel. Overall dimensions are 48in wide by 35in deep by 72in high and the weight is approximately 15 cwt.

Frequency and Time Measuring Equipment

VENNER ELECTRONICS, LTD., Kingston By-Pass, New Malden, Surrey, have recently announced the production of a transistorised frequency and time measuring equipment incorporating plug-in units. The equipment is claimed to be extremely versatile and capable of measuring anything in the range 10 c/s to 50 kc/s, the period of waveform from 0·00001 c/s to 10 kc/s, and the time interval between two consecutive pulses from the same or independent sources from 0·0001 sec to 11½ days. It can also be used to determine the open or closed time of a pair of contacts in the same time range. Digital presentation is



Venner transistorised frequency and time measuring equipment

employed, the indicator for each decade being a meter calibrated from 0 to 9.

When set to measure frequency, any of three gating times may be selected, 0·1, 1 or 10 sec. The count of the unknown frequency will then be carried out for any of the selected periods. In this way, frequency to one decimal place may be determined. Six standard output frequencies are available and any of the six frequencies may be measured by depressing the test switch. An automatic timer is fitted so that repetitive measurements may, if desired, be made without the equipment being operated by hand. The display time is variable from 0·5 to 5 sec.

TV Recording Equipment

A 16 mm television recording equipment, Type BD.679, has been produced by MARCONI'S WIRELESS TELEGRAPH CO., LTD., Chelmsford, Essex. It incorporates a new fast pull-down mechanism which operates in the normal time of 2 millisec, but can be adjusted to give a pull-down actually within the blanking period. A very light gate-pressure is employed, while positive registration of the film is achieved against a sapphire-tipped claw. The fast pull-down mechanism itself is totally enclosed in an oil-bath and can be quickly removed as a sub-unit.

The camera itself is supplied with magazines of 2,250ft capacity, identical for feed and take-up, while a recording monitor, the function of which is to generate an intense high-quality picture for focusing on to the film, is mounted on a swivel head.

Lighting Fittings

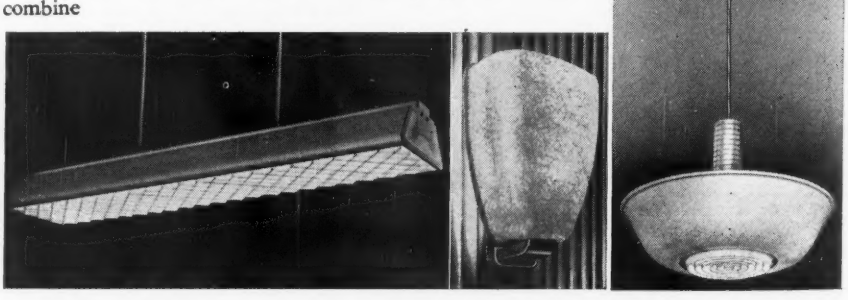
NEW additions to their range of lighting fittings, to be available in September, are announced by the Lighting Division of Philips Electrical, Ltd., Century House, Shaftesbury Avenue, London, W.C.2. The first of these are new industrial trough reflector fittings for 4ft and 5ft bi-pin fluorescent lamps. Known as the "TK" series, they are available with plain or slotted reflectors for single or twin lamps and are equipped with the new Philips polyester silent, cool-running, totally-enclosed, canned ballasts. Coupling and shielding strips can be supplied for row-mounting and the lamps are held by spring-loaded, rotor-type lampholders. The reflector can be easily removed for cleaning purposes. While open ends are standard, there is provision for the fitting of endplates. Metal-framed polystyrene louvres are also available for use with these fittings.

The "TM.10" series all-in-one industrial mounting channels for 40 and 80 W fluorescent lamps combine all accessories such as the new ballasts, starter holders and lampholders, which are pre-wired. The mounting channels are suitable for pendant and surface mounting and they can be used with or without attachments, singly or in rows end to end. Two new commercial attachments for use with the series are also introduced. Type TB17 has two white stove-enamelled steel endplates, two steel-framed "Crinothene" side panels, a metal-framed polystyrene louvre and two white stove-enamelled moulded plastic end motifs. The top is open for maximum light. Type TB15 consists of two white stove-enamelled endplates and side panels of perforated metal treated with clear lacquer to close the perforations and to provide a diffusing effect. A white polystyrene louvre closes the underside of the attachment.

In a new range of tungsten bowl fittings for direct/indirect illumination, the bowl is constructed of glass fibre reinforced polyester resin, a material with a smooth hard surface and good anti-static properties. The W.9102 "Wenlock" is for suspension mounting and the W.9103 "Wenlock" is for ceiling mounting. Both employ 200 W e.s. lamps and the concentric louvre in the base of the bowl is of polystyrene. The suspension set is of polished aluminium with a brass chrome-plated ceiling plate. Also available in this range are the W.9100 "Whitford" for suspension mounting and the W.9101 "Whitford" for ceiling mounting.

Two new wall brackets, also in glass fibre reinforced polyester resin, are the W.9121 "Westminster" and the W.9122 "Woodford." For use with 65 or 75 W b.c. lamps, they are suitable for additional lighting in offices, shops, or in the home. The "Westminster" has an open top and the "Woodford" a closed top.

Philips TB.17 commercial attachment for use with the "TM.10" series mounting channel (left); W.9122 "Woodford" wall bracket (centre); and W.9100 "Whitford" tungsten bowl fitting (right)



France's Electrical Trade

LESS FAVOURABLE BALANCE OF TRADE IN 1956

DURING the past year France's foreign trade and balance of payments position remained serious. While exports declined slightly against 1955, as shown in the following table, imports increased by about 30 per cent.

France's Foreign Trade (£ million)

Year	*Exports*	*Imports*
1954	44·5	19·4
1955	51·2	21·9
1956	48·2	28·7

Among the principal supplying countries (Table 1), the United Kingdom ranks fifth. Electronic equipment plays an important part in British exports to France, as can be seen from Table 2.

French electrical exports, valued at £48·2 million last year, included £23·8 million exports to French possessions overseas, which are not recorded in Tables 3 and 4, being of no great importance to the United Kingdom exporter. Within the French possessions overseas, Algeria proved, as in previous years, France's most important market, followed by Morocco and French East and West Africa. Out of a total of £12 million exported to Algeria, electronic equipment accounted for £1·9 million, cables and wires for £1·2 million and telecommunication equipment for £1·1 million.

Principal French exports included machinery, traction material, and electronic equipment (Table 3). Her main markets for the principal exports are shown in Table 4. (£1=about 1,000 fr.)

Table 1.—French Electrical Imports, 1956: Principal Supplying Countries (Million Francs)

Country	Value
United Kingdom	2,721
West Germany	9,030
U.S.A.	8,209
Holland	3,171
Switzerland	2 726
Belgium	1,014
Italy	652
Sweden	602
Denmark	245
Austria	134
Total incl. other countries	28,726

Table 2.—France's Electrical Imports, 1956: Principal Products (Million Francs)

Product	Value
Rotating machinery excluding traction	2,256
From United Kingdom	185
,, West Germany	791
,, Sweden	149
,, Switzerland	464
,, United States	389
Ditto, parts	435
From United Kingdom	27
,, West Germany	141
,, Sweden	47
,, Switzerland	41
,, Belgium	44
,, United States	117
Transformers up to 10 kVA	44
From United Kingdom	9
,, West Germany	5
,, Holland	7
,, Belgium	11
,, United States	10
Ditto, above 10 kVA to 650 kVA	253
From United Kingdom	15
,, West Germany	95
,, Belgium	59
,, Switzerland	22
,, Italy	18
,, United States	15
Ditto, above 650 kVA to 5,000 kVA	235
From West Germany	114
,, Switzerland	90
,, Italy	13
,, Belgium	5
Ditto, above 5,000 kVA	181
From West Germany	29
,, Italy	23
,, Switzerland	79
,, Belgium	50
Chokes	141
From West Germany	21
,, Italy	17
,, Holland	15
,, Switzerland	54
,, United States	23
Switchgear and parts	2,049
From United Kingdom	119
,, West Germany	885
,, Italy	105
,, Holland	100
,, Switzerland	225
,, United States	546
Voltage regulating, and protecting apparatus	34
From West Germany	17
,, Switzerland	11
,, Belgium	7
Potentiometers and rheostats	161
From United Kingdom	6
,, West Germany	34
,, Sweden	9
,, Switzerland	10
,, Holland	29
,, United States	70
Automatic voltage and current limiters	263
From United Kingdom	19
,, West Germany	60
,, Holland	10
,, Switzerland	94
,, Belgium	32
,, United States	41
Switchboards and control desks	630
From United Kingdom	53
,, West Germany	246
,, Switzerland	116
,, Sweden	21
,, United States	149
Accumulators, lead acid type	68
From West Germany	56
Ditto, others	95
From United Kingdom	84
,, West Germany	6
Batteries	74
From United Kingdom	51
,, West Germany	7
,, Denmark	7
Traction equipment and materials	561
From United Kingdom	16
,, Sweden	334
,, West Germany	89
,, United States	70
Condensers	485
From United Kingdom	69
,, West Germany	89
,, Holland	119
,, Switzerland	85
,, Belgium	31
,, Sweden	19
,, United States	53
Cooking apparatus	207
From United Kingdom	6
,, West Germany	180
,, Switzerland	6
,, Belgium	6
Domestic and industrial water heaters	38
From United Kingdom	2
,, West Germany	8
,, Italy	9
,, Switzerland	12
Electric razors and parts	251
From United Kingdom	5
,, West Germany	37
,, Holland	168
,, Switzerland	25
,, United States	7
Vacuum cleaners	247
From United Kingdom	81
,, West Germany	32
,, Holland	100
Floor polishers	47
From United Kingdom	6
,, West Germany	25
,, Holland	14
Washing machines	97
From United Kingdom	12
,, West Germany	23
,, Holland	11
,, Belgium	41
,, United States	10
Dishwashers	24
From United Kingdom	9
,, West Germany	4
,, Sweden	6
,, United States	5
Other motor driven domestic appliances	311
From United Kingdom	11
,, West Germany	181
,, Italy	48
,, Switzerland	42
,, Belgium	14
Welding electrodes	24
From United Kingdom	2
,, West Germany	20
Heating elements	102
From United Kingdom	8
,, West Germany	44
,, Switzerland	15
,, United States	20
Thermostats	144
From United Kingdom	43
,, West Germany	30
,, United States	36
Hoists, lifts and parts	214
From West Germany	101
,, Switzerland	95
Lamps	692
From United Kingdom	23
,, West Germany	552
,, Italy	40
,, Holland	21
,, Belgium	24
,, United States	21
Filament lamps	271
From United Kingdom	13
,, West Germany	47
,, Holland	36
,, Belgium	45
,, United States	78
Fluorescent lamps	218
From United Kingdom	32
,, West Germany	42
,, Holland	61
,, Belgium	11
,, United States	70
Other lamps	91
From Holland	63
,, West Germany	6
,, United States	19
Electro-medical apparatus	103
From United Kingdom	3
,, West Germany	34
,, Sweden	12
,, United States	34
X-ray apparatus	256
From United Kingdom	4
,, West Germany	116
,, Holland	59
,, Belgium	25
,, United States	16
Household meters	150
From Switzerland	123
,, West Germany	26
Instrument transformers	113
From West Germany	67
,, Italy	14
,, Switzerland	12
,, United States	13
High-frequency generators	289
From United Kingdom	22
,, West Germany	27
,, Holland	43
,, Belgium	16
,, United States	177
Geiger counters	134
From United Kingdom	31
,, West Germany	6
,, Holland	9
,, Sweden	14
,, United States	72
Indicating instruments	796
From United Kingdom	35
,, West Germany	165
,, Holland	88
,, Switzerland	61
,, United States	437
Electronic instruments	363
From United Kingdom	22
,, West Germany	16
,, Holland	32
,, United States	283
Parts of instruments	604
From United Kingdom	69
,, West Germany	102
,, Holland	33
,, Switzerland	74
,, United States	316
Insulators	315
From United Kingdom	37
,, West Germany	129
,, Holland	74
,, Belgium	32
Industrial radio and TV equipment	2,299
From United Kingdom	404
,, West Germany	297
,, Switzerland	132
,, Belgium	104
,, United States	1,238
Other radio and TV equipment including receivers	1,343
From United Kingdom	97
,, West Germany	549
,, Holland	251
,, Switzerland	62
,, Belgium	63
,, Denmark	33
,, United States	216
Radio and electronic accessories and parts	1,881
From United Kingdom	214
,, West Germany	294
,, Holland	378
,, Switzerland	204
,, Sweden	56
,, United States	677
Electronic tubes	2,472
From United Kingdom	160
,, West Germany	127
,, Holland	449
,, United States	1,642
Wires and cables, metal covered	1,337
From United Kingdom	56
,, West Germany	1,041
,, Switzerland	64
,, United States	127
Ditto, without metal covering	353
From United Kingdom	82
,, West Germany	159
,, Holland	78

(Continued on page 342)

Product	Value
(Continued from page 341)	
Teleprinter and telephoto equipment	393
From United Kingdom	46
,, West Germany	113
,, Italy	43
,, United States	100
Telephone and telegraph equipment	302
From United Kingdom	54
,, West Germany	217
,, United States	19
Ditto, parts and accessories	218
From United Kingdom	26
,, West Germany	123
,, United States	29
Signalling apparatus	146
From United Kingdom	28
,, West Germany	41
,, Switzerland	33
,, United States	36
Electrical materials n.e.s.	378
From United Kingdom	43
,, West Germany	75
,, Holland	49
,, United States	103
Washing machines	183
Dish washers	55
Domestic appliances, other, n.e.s.	47
Welding electrodes	6
Heating elements	20
Thermostats	40
Lifts and hoists	425
Lamps, fittings and accessories	364
Lamps, incandescent	138
Lamps, fluorescent	129
Lamps, other	11
Lamps, parts thereof	46
Electro-medical apparatus	183
X-ray and radiological apparatus	156
Household meters	160
Instrument transformers	355
High-frequency generators	85
Geiger counters	15
Indicating instruments	403
Electronic instruments	125
Professional and laboratory instruments	653
Parts of meters, instruments, etc. n.e.s.	287
Insulators, porcelain	439
Insulators, other	16
Insulator parts and ceramic materials	28
Insulators, glass	128
Insulators, glass, parts	10
Insulating materials	98
Radio and TV transmitting and receiving equipment	905
Radio telephone and telegraph equipment	47
Radar, and echo sounding equipment	287
Electronic calculators	35
Induction heating apparatus	62
Radio receivers and radio gramophones	110
TV receivers with or without radio incorporated	27
H.F. amplifiers	10
Sound reproducers	49
Loudspeakers	39
Aerials	119
Radio components and parts	226
Condensers, variable	41
Resistances	72
Relays	294
Other electronic parts, and apparatus n.e.s.	175
Transmitting tubes	828
Receiving tubes	590
Cathode ray tubes	27
Rectifier bulbs	34
Tubes and parts	33
Cables and wires	2,677
Telecommunication and signalling equipment	1,133
Miscellaneous	185

Table 3.—France's Electrical Exports, 1956 (million francs)

Product	Value
Rotating machinery, other than traction	2,830
Rotating convertors	126
Transformers up to 10 kVA	41
Transformers between 10 and 650 kVA	330
Transformers between 650 and 5,000 kVA	325
Transformers above 5,000 kVA	1,219
Reactor coils	20
Rectifiers	120
Switchgear, voltage and current limiters	2,337
Line and traction accessories	98
Switchboards	1,206
Installation material	444
Accumulators, lead acid type	92
Accumulators, others	589
Batteries	152
Torches	42
Traction equipment	1,324
Condensers	164
Cooking appliances	36
Space heaters	37
Water heaters	37
Hair dressing equipment	29
Razors	74
Fans	15
Vacuum cleaners	28
Floor polishers	4

Table 4.—France's Electrical Exports, 1956, in order of importance (million francs)

Country	Total Value	Product Group	Value
Holland	2,676	Traction material	862
		Distribution material	273
		Electronic tubes	256
		Telephone and telegraph equipment	212
		Cables and wires	205
		Rotating machinery	178
Luxembourg	2,371	Distribution material	422
		Radio components	270
		Rotating machinery	249
		Domestic appliances	208
		Measuring and indicating instruments	184
		Electronic tubes	143
		Accumulators, lead acid	142
Spain	2,165	Static machinery	679
		Distribution material	287
		Industrial radio equipment	208
		Rotating machinery	370
		Measuring and indicating instruments	128
		Radio components	116
Turkey	1,402	Static machinery	310
		Rotating machinery	156
		Distribution material	146
		Cables and wires	124
		Telephone and telegraph equipment	117
United States	1,107	Electronic tubes	384
		Measuring and indicating instruments	181
		Accumulators, lead acid	166
Italy	1,089	Electronic tubes	143
		Measuring and indicating instruments	138
		Telephone and telegraph equipment	122
West Germany	969	Rotating machinery	563
		Industrial radio equipment	66
		Distribution material	56
Portugal	917	Distribution material	209
		Static machinery	162
		Railway traction	132
		Industrial radio equipment	102
Venezuela	894	Cables and wires	509
		Static machinery	120
		Distribution material	117
Switzerland	872	Rotating machinery	112
		Porcelain insulators	107
		Measuring and indicating instruments	106
United Kingdom	669	Measuring and indicating instruments	144
		Electronic tubes	100
		Rotating machinery	84
Brazil	655	Distribution material	192
		Static machinery	134
		Rotating machinery	117
Argentina	597	Telephone and telegraph equipment	296
		Rotating machinery	53
Lebanon	517	Static machinery	194
		Distribution material	78
Egypt	485	Cables and wires	133
		Signalling apparatus	68
Sweden	436	Electronic tubes	72
		Measuring and indicating instruments	69
		Industrial radio equipment	63
India	437	Distribution material	93
		Static machinery	59
		Measuring and indicating instruments	54
Denmark	395	Cables and wires	157
		Rotating machinery	141
Yugoslavia	368	Industrial radio equipment	90
		Distribution material	75
Greece	355	Industrial radio equipment	93
		Cables and wires	83
Ceylon	350	Distribution material	172
		Static machinery	71
Mexico	320	Industrial radio equipment	114
		Domestic appliances	118
		Cables and wires	81
Iran	282	Distribution material	101
		Cables and wires	60
Russia	260	Cables and wires	185
		Radio receivers	29
Iraq	256	Rotating machinery	82
		Distribution material	76
Colombia	254	Distribution material	116
		Cables and wires	42
Saudi Arabia	245	Cables and wires	126
		Hoists and lifts	54
Pakistan	235	Railway traction	110
		Accumulators, lead acid	52
		Industrial radio equipment	15
Finland	184	Cables and wires	37
		Rotating machinery	25
Syria	181	Cables and wires	95
		Distribution material	31
Peru	162	Distribution material	45
		Cables and wires	42
Uruguay	161	Cables and wires	79
		Static machinery	36
Cuba	147	Cables and wires	91
		Hoists and lifts	43
Norway	128	Distribution material	24
		Rotating machinery	19
Austria	121	Measuring and indicating instruments	39
		Industrial radio equipment	18
Canada	121	Distribution material	48
		Electronic tubes	36
Chile	92	Rotating machinery	31
		Static machinery	13
Indonesia	81	Rotating machinery	26
		Static machinery	18
Belgian Congo	65	Industrial radio equipment	10
		Accumulators, lead acid	9
		Rotating machinery	7
South Africa	57	Lifts and hoists	40
		Rotating machinery	3
Australia	57	Glass insulators	14
		Distribution material	9

I.E.C. PUBLICATIONS

THREE new publications (two being first editions) have recently been issued by the International Electrotechnical Commission, 1, rue de Varembé, Geneva, Switzerland. One of these (No. 84, 95 pages, 15 Swiss francs) sets out recommendations for mercury-arc a.c. to d.c. convertors of at least 50 kW rated power, 10 A d.c. and 5,000 V d.c. Its five sections relate to definitions, valves, characteristics of associated transformers differing from those of power transformers, convertors and tolerances.

The second publication (No. 86, 37 pages, 7·5 Swiss francs) deals with dry primary cells and batteries with depolarisers, usually (but not necessarily) of manganese dioxide. The object of the recommendations is to enumerate and define the characteristics of the types corresponding to most needs, to secure interchangeability and to limit the number of designs.

The remaining document (No. 50, 75 pages, 8 Swiss francs) is a second edition of Group 15 (switchboards and apparatus for connection and regulation), one of 22 groups which will form the complete International Electrotechnical Vocabulary. It contains 260 terms and definitions in English and French and the equivalent terms in six other European languages.

NUCLEAR POWER STATION FOR WALES

C.E.A. Merionethshire Project

THE Central Electricity Authority proposes to make early application to the Minister of Power and the Local Planning Authority for consent to erect its fourth nuclear power station at Trawsfynydd, Merionethshire. The Authority has reached the conclusion that a suitable site for nuclear power generation in North Wales exists also at Edern (or Edeyrn), Caernarvonshire.

The Trawsfynydd site is on the northern shore of the artificial lake of that name which was created some thirty years ago to serve as the storage reservoir for the Maentwrog hydro-electric power station. The lake is large enough to provide cooling water for a nuclear power station of up to 500 MW capacity. The land, which is owned by the Authority, is rocky and broken and of no agricultural value; the reactors can be founded directly on rock.

The proposal for Trawsfynydd will be a station of 400-500 MW capacity, to be brought into service in 1962, and connected by overhead line to the 275 kV transmission system at the Ffestiniog pumped storage station now under construction some five miles to the north.

The Edern site is some two miles west of the village of that name and is on the northern coast of the Lleyn Peninsula. It consists mainly of rough heathland and low cliffs. After excavation the reactors could be founded directly on rock. This site is suitable for a larger development than Trawsfynydd, as unlimited cooling water is available from the sea with deep water close inshore. The timing of proposals for Edern will depend upon system requirements and the scale of the nuclear power programme as a whole.

Trawsfynydd, a village 800ft above sea level, 12 miles north of Dolgelly, has a population of about 1,400. Survey and trial borings have been taking place there for some months. The Merioneth County Council has been urging the C.E.A. to site an atomic research establishment or a power station in the area.

Mr. C. J. Tuck, the county planning officer, says that there is likely to be unemployment in the area because of the closing of an army camp. A nuclear power station would give employment to about 400. The height of the buildings would not be more than 150ft and there should be little disturbance to the natural scenery of Snowdonia.

The Trawsfynydd site is inside the boundary of the Snowdon National Park. A spokesman of the National Parks Commission declined to comment when the C.E.A.'s announcement was made, but the chairman of the Commission, Lord Strang, is on record as saying that, in projects like this, the would-be developer should be able to show conclusively why no other site, less damaging to the amenities, could not be used.

Mrs. Cicely Williams-Ellis, chairman of the Caernarvonshire branch of the Council for the Preservation of Rural Wales, said last week that she was "very concerned" about the likely effects of the nuclear station at Edern, and the County Committee would give the matter very serious consideration. She stated that if it was the intention to link Edern with the new pumped storage station at Blaenau Ffestiniog, or with any other site in Snowdonia, there would be serious damage done to the landscape and, inevitably, within the National Park itself.

Blaenau Ffestiniog pumped storage scheme. The valley which will hold the lower reservoir of the pumped storage plant, the largest in the world, now under construction near Blaenau Ffestiniog. The projected Trawsfynydd nuclear power station will be connected to the 275 kV grid at Ffestiniog

[Photograph by *The Times*

GENERATION AND DEVELOPMENT

Sales of New Domestic Appliances

The accompanying table shows the number of new appliances sold by Area Electricity Boards in England and Wales for the year as well as the quarter ended 30th June last, together with percentage changes over corresponding periods of the previous year. When assessing the figures, it must be remembered that the sales by Area Boards represent only a part of the total sales throughout the country.

Appliance	Sales in quarter ended 30th June, 1957		Sales in twelve months ended 30th June, 1957	
	Total	% Change over corresponding period of previous year	Total	% Change over corresponding period of previous year
Cookers	56,525	+ 7·3	218,738	+ 5·1
Water Heaters:				
Immersion ...	50,161	− 2·5	134,702	− 7·4
Storage	10,953	− 0·3	41,575	− 2·0
Wash boilers ...	19,964	+31·8	74,049	+32·9
Washing Machines ...	18,048	+ 3·9	70,022	−33·3
Refrigerators ...	17,588	+30·3	37,481	−24·6

200 MW Units for Willington "B"

The Central Electricity Authority has received the consent of the Minister of Power to the extension of Willington power station, Repton, Derbyshire, by the installation of two 200 MW turbo-generators and two reheat boiler units in the "B" section. Each boiler will have an evaporative capacity of 1,400,000 lb/hr. In the "A" station, now under construction, there will be four 100 MW turbo-generators each served by a single boiler having an evaporative capacity of 830,000 lb of steam an hour.

Output in July

Last month 6,276 million kWh was generated by the Central Electricity Authority, the North of Scotland Hydro-Electric Board and the South of Scotland Electricity Board. This was 7·5 per cent more than in July, 1956, compared with the average increase for the first six months of the year of only 1 per cent. Plant capacity was unchanged during July at 25,384 MW.

In the four weeks ended 27th July 646·4 million kWh was generated by industry, an increase of 11·1 per cent. This included 44 million kWh produced at Calder Hall.

Delivery of Accounts

The London Electricity Board, which has about 1,700,000 consumers, is experimenting in certain districts with the delivery of consumers' bills by hand. For this purpose the Board is employing meter readers, pensioners and part-time workers and expects that the method will result in considerable saving. Delivery of accounts by hand has been practised by the North Western Electricity Board for some time. About one-third of the bills (some 500,000) are dealt with in this way and it is claimed that there is a saving to the Board of £2,400 a quarter.

Teignmouth and Dawlish Supply Improvement

The South Western Electricity Board has in hand a £92,000 scheme to reinforce and improve supplies to consumers living at Teignmouth and Dawlish. Mr. A. W. Allwood, manager of the Board's Torbay District, said last week that a new 33 kV overhead line was being constructed from Newton Abbot to Teignmouth where the building of the new substation was well under way. This line would augment the existing 11 kV line which had become overloaded because of the increasing local demand for electricity. Since the supply had to be taken along the valley of the Teign and country areas of scenic beauty, routing required special care.

Work was also proceeding on the extension of the 33 kV line to Dawlish, and all the poles were up. The completion of the scheme would bring still greater security of supply to over 12,000 consumers living in the Teignmouth and Dawlish areas, and the new substations would improve voltage conditions. All the work was being accomplished without interrupting existing supplies to consumers.

Eventually it is hoped to provide a 33 kV ring main system, from Newton Abbot to Teignmouth, Dawlish, Chudleigh and back to Newton Abbot, to meet the ever increasing electrical demand in South Devon.

Revised North Eastern Tariffs

The North Eastern Electricity Board has published details of the proposed increases in electricity charges which, as recently announced, will come into operation on 1st October. Under the quarterly domestic tariff the first block will be charged at 5d/kWh (against 4½d) and the second block at 2½d (2d). The final block remains at 1d/kWh. No alteration will be made for prepayment meter consumers.

Farm, commercial and industrial tariffs, and tariffs for places of worship have also been revised.

New tariffs to be introduced include an off-peak restricted hour tariff of 0·85d/kWh; a general purpose block tariff for commercial and industrial premises, and places of worship where the total demand for all purposes does not exceed 40 kW; a commercial catering tariff for hotels, restaurants, boarding houses, etc., where heavy duty electric cooking apparatus is installed; a commercial maximum demand tariff; and new industrial tariffs for premises where all the energy used is supplied by the Electricity Board.

Londonderry Coal Clause Raised

As a result of the increases in the costs of coal, transport and dock charges, which will add £10,000 to Londonderry Corporation Electricity Department's bill this year, an adjustment will be made in the coal clause for the next quarter of 0·1d/kWh. This was announced last week by the city electrical engineer, Mr. Stuart Spence. He said that in the average household the annual electricity consumption was about 1,000 kWh and the increase would mean an extra charge of about 8s 4d a year.

Higher Charges in Belfast?

According to the *Belfast Telegraph*, electricity charges in the Belfast Corporation's supply area are likely to be raised within the next twelve months. In the annual report of the city electricity engineer and general manager (Mr. R. P. Watson), which was presented to the Electricity Sub-Commit-

ELECTRICITY GENERATED AND SENT OUT FOR PUBLIC SUPPLY

	Fuel consumed Thousand tons			kWh generated Millions			kWh sent out Millions	Installed capacity (m.c.r.) MW
	Coal	Coke and Breeze	Oil	Steam	Water power	Total		
Central Electricity Authority ...	2,982	55	34·8	5,802	14	5,821	5,444	23,160
North of Scotland H.E.B. ...	12	—	1·2	19	63	87	86	831
South of Scotland E.B. ...	185	4	0·2	359	9	368	347	1,393
Total for July, 1957	3,179	59	36·2	6,180	86	*6,276	5,877	25,384
Corres. total for July, 1956 ...	2,985	70	32·6	5,750	79	5,840	5,472	23,025
Inc. or dec., per cent	+6·5	−15·3	+11·1	+7·5	+8·1	+7·5	+7·4	+10·2
Total to date (7 months), 1957 ...	25,917	517	196·2	50,147	1,176	51,399	48,296	
Total for corres. 7 months of 1956	25,912	561	240·0	49,621	797	50,519	47,459	
Inc. or dec., per cent	—	−7·9	−18·2	+1·1	+47·5	+1·7	+1·8	

* The total figure includes generation by other methods amounting to 10 million kWh.

tee on 12th August, it was stated that revenue during the current year was unlikely to offset the increased costs, even if there were a substantial increase in sales and greater efficiency in generation. Mr. Watson stated that loan charges during the current year were expected to be considerably greater owing largely to capital expenditure on the new power station. In addition, further substantial salary and wage increases had been awarded which, in a complete year, would increase costs by approximately £47,000, while prices of materials and equipment were still mounting.

Referring to the new power station, Mr. Watson said that the strenuous efforts which had been made in the past eighteen months had resulted in accelerating the work of erecting the buildings and installing the plant to such an extent that the first of the three 60 MW hydrogen-cooled sets should be ready for service before the coming winter. Thus the danger of load shedding which confronted the Province last year would be obviated.

With regard to street lighting, he said that the Corporation had decided to change over completely from gas to electricity for lighting within the city.

East Midlands Handbook

We have received from the East Midlands Electricity Board, Mapperley Hall, Nottingham, a copy of its handbook (dated July, 1957) which contains a great deal of information about the Board's organisation, including particulars of its Sub-Areas and Districts, including the names of all the principal officers. Six pages are devoted to the Electricity Consultative Council.

Douglas Engineer's Report

We regret that in the note under this heading in last week's issue we incorrectly stated the Douglas borough electrical engineer's name—he is Mr. C. Anderson, M.I.E.E.

OVERSEAS

Power Shortage in Argentina

The *Fortnightly Review* of the Bank of London and South America reports that the Minister of Trade and Industry, Dr. Julio C. Cueto Rúa, again drew attention recently to the grave shortage of electricity in Argentina. The country's total installed capacity was, he said, 2,150 MW, of which 785 MW was owned by the State concern ENDE, 1,230 MW by private and co-operative concerns, and 135 MW by provincial, municipal and other official organisations. Of this total, however, 375 MW installed by the ENDE was not yet in full operation and 180 MW needed immediate replacement. A further 250 MW was provided by antiquated machinery that would need replacement before long.

The present deficit, the Minister said, was 750 MW, but by 1962-63 Argentina would need an additional 2,400 MW of installed capacity, making a total of at least 4,000 MW. Equipment for this would cost U.S.$310 million but, if certain proposals for financing the cost of the new Dock Sud and El Chocón plants did not materialise, this figure would have to be raised to U.S.$500 million.

Tenders for building a thermal plant in Dock Sud for the ENDE were opened on 27th June. The plant, which is to have an installed capacity of 600 MW, is to be built on land reclaimed from the Río de la Plata. The firms tendering included the Metropolitan-Vickers Electrical Export Co., Ltd., and the British Thomson-Houston Export Co., Ltd., together with International Combustion, Ltd., and Babcock & Wilcox, Ltd. The offers are being studied by a special Argentine commission. The cost is about U.S.$120 million and the plant is to be built within four years. Most of the offers included eight years' deferred payments terms.

Large New Zealand Project

The Wellington correspondent of the *Financial Times* reports that the New Zealand Government has announced its intention of making an immediate start on the Benmore hydro-electric scheme, the largest single project yet undertaken in the country. It will have an installed capacity of 480 MW (six 80 MW units) and will be built on the Waitaki River in the South Island.

Tasmanian Hydro-Electric Scheme

The Hydro-Electric Commission of Tasmania plans to build a 400,000 h.p. power station near Cressy. It will be fed by water from the northern end of Great Lake. The scheme, which has the approval of an English firm of consulting engineers, comprises a four-mile tunnel from Great Lake through the Western Tiers to an underground power station about 10 miles from Cressy. The project is planned for completion in about 1963, at an estimated cost of between £25 million and £30 million. After use in the station, the water will be stored in a special dam and then regulated down the South Esk river and used again at Trevallyn power station.—*Tenders* (Melbourne).

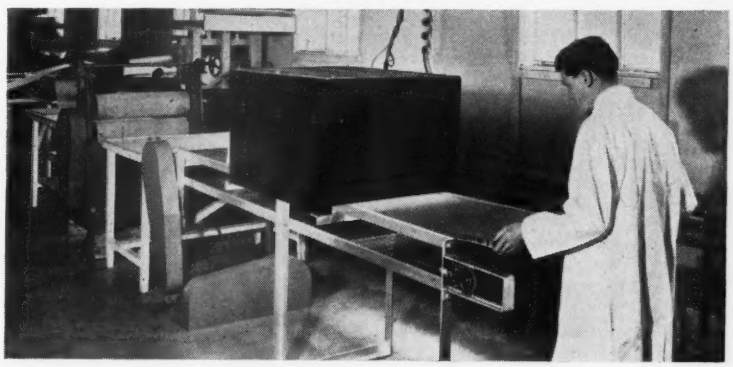
Speedier Production of Laminates

A new bonding technique to cut the cost of making laminates and to speed production has been introduced by the Armstrong Cork Co., Ltd. Use is made of a rubber solution adhesive which is rapidly heated by infra-red plant to evaporate the solvents and reactivate it. The complete bonding process, including the spreading of the adhesive, is completed in a few minutes and there is no need for expensive presses and curing ovens.

To demonstrate the applications of the new adhesive a simple processing line has been installed by the company. It employs a conveyor-fed infra-red heating unit, an assembly table and pinch rolls. In the demonstrations the adhesive is applied by hand spray or roller and the coated components are placed on a horizontal ladder type conveyor belt which carries them through the heating unit. This unit is a small infra-red heating plant designed and manufactured by the General Electric Co., Ltd. In this plant the adhesive coating is rapidly heated to the required temperature by radiation from a horizontal bank of "Osram" infra-red reflector lamps. The plant has a loading of 7½ kW, will accommodate sheets up to 2ft 6in in width and normally takes only 60 sec to heat an adhesive coating to the required temperature. The conveyor speed can be varied to give the slightly longer or shorter heating times which may be necessary when coating some materials.

It is estimated that using the new technique a production line occupying approximately 360 sq ft of floor space can produce laminates at the rate of some 2,500 sq ft an hour.

Processing line used by the Armstrong Cork Co., Ltd., to demonstrate the company's new bonding technique



Financial Section

STOCKS and SHARES

ANOTHER relapse in gilt-edged stock prices has to be recorded as the principal feature of Stock Exchange markets over the past week or so. This extinguished quickly the flicker of recovery which in the first half of this month had begun to brighten the hopes of holders of Government securities. By the beginning of this week War Loan had lost its previous gain of two points in sinking to another all-time low point. British Electricity stocks had come back by one to two points. Responsibility for this reverse was put partly on a new House rule affecting certain types of dealing, but mainly on currency uncertainties arising from the "devaluation" of the franc. More general influences included the weak state of Wall Street and the commodity markets, and the fresh anxieties from the Middle East. In the industrial market, business contracted to small dimensions, but prices were fairly well held.

Price Changes

Shares showing low yields on the basis of present dividends have tended lately to lose some favour because of an apparently greater reluctance on the part of the investor to take long views. This disposition is held to account for recent declines in shares such as Plessey (which at 72s stand now some 14s below the best prices ruling earlier this year), Simon-Carves and Clarke Chapman. Among other shares in the low-yielding category, Elliott Bros. and Associated Automation turned easier in advance of the detailed particulars of the proposed merger of these two companies. As a rule, however, electrical share prices have stood their ground reasonably firmly, and good points have not been lacking: Dewhurst & Partner, for instance, moved up to their best price of the year at 7s 9d, and E.M.I. at 36s shared that distinction before reacting to 35s.

Electronic Telephones

Future possibilities of the electronic telephone exchange have for some time been a factor in maintaining the popularity of shares in the leading manufacturers of telephone equipment, and in their quotation on a yield basis below the average. Interest was encouraged consequently by the report that the first practical working unit has recently been put into service at the headquarters of British Telecommunications Research, sponsored by Automatic Telephone & Electric and B.I.C.C. The £1 shares of the former, quoted at 74s, are standing only a little short of their best price of the year: the yield is a fraction under 4¾ per cent. Among other shares in the field, Ericsson Telephones 5s shares have also maintained their value exceptionally well, and show a yield equivalent to approximately 4 per cent gross on the 22 per cent tax-free payment. Both these companies raised their distributions this year by 2 per cent, and in each case the present rate is covered three times or more by the net profits.

Walsall Conduits

A yield of 6 per cent on a well-covered dividend is available from the 4s

Price Changes in

Company or Board	Nom. Value	Middle price 19th Aug.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1957 Highest	1957 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	72½	−2	3	3	4 1 9	80	71½
Brit. Elec. 1974/77	100	68⅝	−2	3	3	4 7 6	78¼	68⅝
Brit. Elec. 1976/79	100	73½	−1	3½	3½	4 15 3	81½	73½
Brit. Elec. 1974/79	100	84½	−1	4¼	4¼	5 0 6	92½	83½
Overseas Electric Supply								
Calcutta Elec.	£1	16/3		6†	6†	7 7 9†	19/-	15/-
East African Power	£1	20/6		7	7	6 16 6	21/-	19/-
Nigerian Elec.	£1	17/6		10	10	11 8 6	18/6	17/3
Perak Hydro-Elec.	£1	17/6		10	10*	11 8 6	18/-	13/3
Electrical Shares								
Aberdare Cables	5/-	12/6		17½	17½	7 0 0	12/6	9/9
Aerialite	1/-	6/6		45	48	7 7 6	6/6	4/9
Allen, W. H.	£1	47/-		10	10	4 5 0	47/3	33/6
Anglo-Portuguese Tel.	£1	24/3		8	8	6 12 0	27/6	20/6
Aron Elec. Ord.	£1	58/9		15	15	5 2 3	60/-	53/6
Assd. Automation	10/-	22/9	−1/3	5	7½	3 6 0	24/9	17/9
Assoc. Elec. Ord.	£1	60/-		15	15	5 0 0	73/-	60/-
Automatic Tel. & El.	£1	74/-	+3d	15	17	4 12 0	75/-	54/6
Babcock & Wilcox	£1	73/3	−6d	15	15	4 2 0	82/6	70/-
Bakelite	10/-	23/3	−3d	16	15	6 9 0	24/6	20/9
Baldwin, H. J.	2/-	4/6	−3d	20	20	8 17 9	5/-	3/10½
Berry's Electric	5/-	6/6		—	10	7 13 9	6/6	5/6
British Aluminium	£1	58/9	−9d	12	12	4 1 9	71/3	58/9
Brit. Elec. Traction: Def. Ord. "A" ...	5/-	25/-		22½	25	5 0 0	25/-	17/-
B.I. Callender's	£1	49/9	+6d	12½	12½	5 0 6	55/-	48/3
B.I. Callender's 6% Pref. ...	£1	20/6		6	6	5 17 0	21/9	19/6
British Tabulating	£1	51/3	−3/3	9	9	3 10 3	56/3	42/-
British Thermostat	5/-	25/-		25	25	5 0 0	27/6	25/-
British Vac. Cleaner	5/-	6/-		15	10	8 6 9	8/-	6/-
Brook Motors	10/-	37/6		25	25	6 13 3	37/6	30/-
Brush Group	5/-	7/9		10	Nil	—	8/-	4/6
Bulgin, A. F.	1/-	4/9		50	40*	8 8 6	5/6	4/6
Burco Dean	5/-	13/3	−3d	22½	20	7 11 0	14/-	8/9
Cable & Wireless: Ord.	5/-	12/6		10	10	4 0 0	12/6	9/6
4% Loan	100	90⅛		4	4	4 8 6	92½	89
Chloride El. Storage "A" ...	£1	66/-	−1/-	17½	17½	5 6 0	68/9	58/-
Clarke Chapman	£1	165/-	−5/-	22½	27½	3 6 9	9	6¼
Cole, E. K.	5/-	20/9	−3d	17⅜	17⅜	4 4 3	23/6	16/6
Cossor, A. C.	5/-	6/9	−3d	15	Nil	Nil	7/3	5/9
Crabtree	10/-	25/-		20	20	8 0 0	26/-	23/3
Crompton Parkinson Ord. ...	5/-	16/6		16	16	4 17 0	17/9	14/6
De La Rue	5/-	24/3	−6d	30	35	7 4 3	24/9	16/3
Decca "A"	4/-	29/3	−3d	43¾	43¾	5 19 9	32/3	26/10½
Desoutter	5/-	35/6		30	32½	4 11 6	35/6	27/6
Dewhurst	2/-	7/9	+3d	30	16¼*	4 3 9	7/9	5/9
Dictograph Tel.	2/-	5/9		20	20	—	6/3	5/9
Dubilier Condenser	1/-	6/3	−3d	30	30	4 16 0	7/6	5/6
Duport	5/-	21/-		23	25	5 19 0	21/-	17/6
E.M.I.	10/-	35/-	+6d	15	15	4 5 9	36/-	23/9
Electrical Components	5/-	8/-		25	12½*	7 16 3	8/-	6/6
Elec. Construction	£1	25/-		8⅛	8⅛	6 16 0	27/6	21/9
Elliott Bros.	5/-	29/9	−1/3	17½	20	3 7 3	33/6	26/3
Enfield Cable Ord.	£1	16/6	+1/-	Nil	Nil	Nil	21/6	13/-
English Electric	£1	61/3		12½	14	4 11 6	65/-	47/6
English Electric 3¾% Pref. ...	£1	12/-		3¾	3¾	6 5 0	14/3	13/-
Ericsson Tel.	5/-	48/6		20†	22†	2 5 6†	50/-	33/3
Ever Ready	5/-	18/9	+3d	35	37½	5 0 0*	20/-	15/-
Falk Stadelmann	£1	38/3	+9d	17⅛	17½	9 3 0	40/6	35/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

ordinary shares of Walsall Conduits, which stand at about 13s 3d and have proved to be a consistently satisfactory investment over a long period. Shareholders have had two scrip issues within the last five years, followed on both occasions by an increase in the dividend, while earnings have expanded by about 50 per cent in the same time. In the latest balance sheet, the reserves are shown to be just about equal to the issued ordinary capital of £800,000; and the position is notably strong in net liquid assets, totalling £1½ million.

Electrical Investments

Company or Board	Nom. Value	Middle price 19th Aug.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1957 Highest	1957 Lowest
Electrical Shares—continued								
G.E.C. Ord.	£1	48/9		14	12½	5 2 6	58/9	48/9
G.E.C. 6½ Pref.	£1	20/6		6½	6½	6 6 9	23/6	20/6
General Cables	5/-	15/6		30	30	9 13 6	15/6	11/6
Greenwood & Batley	£1	47/6		17½	17½	7 7 3	47/6	45/3
Hackbridge Holdings	5/-	15/3		30	20	6 11 3	21/9	15/-
Hackbridge & Hewittic	5/-	13/9		23	20	7 5 6	16/-	13/6
Head Wrightson	£1	135/-	−2/6	20	22½	3 6 9	146/3	112/6
Heatrae	2/-	4/9		15	15	6 6 6	4/9	4/-
Henley's	10/-	14/3		11½	11½	8 1 6	17/-	14/3
Holophane	5/-	23/9		30	30	6 6 3	26/3	17/-
Hoover	5/-	38/-		50	50	6 11 6	44/-	24/9
I.C.I.	£1	42/3		10	10	4 14 9	46/6	37/9
Intl. Combustion	5/-	25/6		20	22½	4 8 3	30/-	20/-
Johnson & Phillips	£1	27/-		15	10	7 8 3	34/6	27/-
Lancashire Dynamo	£1	40/-		11	11	5 10 0	45/-	36/9
Laurence, Scott	5/-	17/9		15	15	4 4 6	19/9	13/9
Lister, R. A.	£1	30/9	−6d	10	10	6 10 0	33/9	26/9
London Elec. Wire	£1	48/3	+3d	12½	12½	5 3 9	53/9	43/-
Lucas, J.	£1	33/3		7½	7½	4 10 3	36/6	30/6
Marconi Marine	£1	36/6		10	10	5 9 6	37/-	31/-
Marryat & Scott	2/-	12/6		30	35	5 12 0	13/-	8/-
Mather & Platt	£1	58/9		15	15	5 2 3	63/9	51/3
Metal Industries	£1	27/-	+6d	Nil	9	6 13 3	30/-	20/3
Midland Elec. Mfg.	£1	50/-		12½	12½	5 0 0	50/-	45/-
Morphy-Richards	4/-	17/3	−1/-	50	50	4 12 9*	20/-	11/9
Murex	£1	71/9	+6d	20	20	5 11 6	79/6	65/-
Newman Ind.	2/-	2/9		10	10	7 5 6	2/9	2/1
Oldham & Son	1/-	2/9		17½	17½	6 7 3	2/9	2/3
Parnall (Yate)	5/-	7/-		12	12	8 11 6	8/9	5/9
Parsons, C. A.	£1	63/9		10	8¼*	—	71/3	50/6
Plessey	10/-	72/-	−4/-	27½	30	4 3 3	86/3	61/-
Pye "A" Deferred	5/-	16/3		12½	12½	3 17 0	20/-	15/9
Reyrolle	£1	97/-	−1/-	16½	17½	3 12 3	110/-	90/-
Rheostatic	4/-	9/-		18⅜	12½*	5 11 0	10/-	8/9
Richardsons Westgarth	5/-	18/-	−6d	16⅝	16⅝	4 12 6	20/-	17/-
Scottish Cables	4/-	18/3		27½	27½	6 0 6	19/3	15/-
Simon-Carves	5/-	31/3		28⅞	20*	3 4 0	36/3	26/-
Smith (England), S.	4/-	15/-		17½	17½	4 13 3	15/9	13/-
Southern Areas	£1	14/6	−1/-	7½	7½	10 6 9	20/-	13/9
Strand Elec.	5/-	7/3		15	15	10 6 9	8/-	7/3
Sturtevant	5/-	22/9		15†	15†	3 6 0†	27/-	22/9
Sun Elec.	£1	43/9		20	25	11 8 6	43/9	43/9
Switchgear & Cowans	5/-	13/6		25	25	9 5 3	15/6	13/6
Taylor Tunnicliff	5/-	12/3		15	15	6 2 6	13/9	11/9
T.C.C.	10/-	41/3	+1/3	25	25	6 1 3	41/3	35/-
T.C. & M.	£1	26/-		8½	8½	6 10 9	31/-	24/6
Telephone Mfg.	5/-	5/6		10	10	9 1 9	8/-	5/6
Telephone Rentals	5/-	11/6		12½	12½	5 8 9	12/6	10/3
Thompson (John)	5/-	33/-		25	25	3 15 9	37/-	29/3
Thorn Elec.	5/-	25/-		15	17½	3 10 0	26/3	16/3
Thornycroft	£1	27/6		15	12½	9 1 9	37/6	27/6
Tube Investments	£1	65/9	−1/9	22½	15*‡	4 11 3	68/9	58/3
Vactric	5/-	20/-		17½	25	6 5 0	23/9	12/9
Veritys	5/-	9/-		12½	12½	6 19 0	9/3	8/-
Walsall Conduits	4/-	13/3	−3d	20	20	6 0 9	15/-	11/-
Ward & Goldstone	5/-	56/3	−1/3	35	40	3 11 0	57/6	36/9
Watford	2/-	6/6		25	25	7 13 9	6/9	6/3
Westinghouse	£1	37/6		18	9‡	4 16 0	41/3	36/-
West, Allen	5/-	12/-	+6d	15	15	—	13/6	9/6
Wolf Electric	5/-	11/-		20	20	4 10 9*	13/6	8/9

Last year the volume and value of sales broke all records and the net profit improved by more than 20 per cent. At the annual meeting the chairman was concerned over the continuous rise in production costs, but although demand this year was described as being less intense than previously, he reported that sales in the current year were above last year's corresponding level.

British Aluminium Issue

The new £1 ordinary shares of the British Aluminium Company have been dealt in at a premium of about 1s 6d on the price of 58s at which two million shares are offered to the company's shareholders by way of rights. This fresh capital is required for the development of several of the group's relatively new projects, notably the big Canadian undertaking which is expected to reach the first stages of production about the end of this year. In a circular to shareholders, the directors describe current trading results as satisfactory. They expect to maintain this year's interim dividend at 4 per cent on the existing ordinary capital, and to be able to pay a final dividend of 8 per cent (as for last year) on capital increased by the issue of new shares. The latter are at present nil paid, with 30s payable by 6th September and the balance of 28s by 15th October. Meanwhile they are transferable free of stamp duty and offer a prospective yield of just over 4 per cent at the all-in price of 59s 6d.

Other New Issues

Holders of British Tabulating Machine £1 shares are to be offered early next month 800,000 new shares at 33s. This is some 18s 3d below the market price of the existing shares, which were marked down by about 3s after the announcement. Duport, Ltd., who absorbed Revo Electric a year ago, announce an issue of nearly £2 million 6 per cent debenture stock, of which £1 million has been allotted in exchange for Briton Ferry Steel debenture stock while the remainder is being placed privately.

Newton Bros. Results

The 2s ordinary shares of Newton Brothers (Derby), who have lately published their results for the twelve months ended in March, are quoted at about 4s 3d, showing a yield of over 9 per cent on the basis of the 20 per cent distribution now declared. This is at the same rate as for the two previous years and is made up of a 12½ per cent dividend and 7½ per cent bonus. According to the preliminary figures, it is covered practically twice over by the net profit, which at £59,000 comes out some £8,000 below the level of 1955–56. In advance of the full report this contraction was assumed to be the outcome of factors mentioned at last year's meeting, when the chairman referred to the effects of keen competition aggravated by increases in labour and other costs.

REPORTS and DIVIDENDS

Dubilier Condenser Co. (1925), Ltd.—The accounts for the year ended 31st March last show a profit, after meeting taxation and other charges, of £157,538, against £190,715 for the preceding year. To this is added £116,976 brought forward making £274,514. The ordinary dividend is maintained at 30 per cent, £107,756 (against £155,000) is transferred to general reserve and £123,832 is carried forward.

The directors recommend that £107,756 5s from the general reserve shall be capitalised and distributed to the ordinary shareholders in the form of one ordinary share for each two held. In order to provide ordinary capital for future issue, it is proposed to sub-divide and convert the 300,000 unissued 10 per cent non-cumulative preference shares into 3,000,000 1s ordinary shares and to increase the authorised capital from £650,000 to £750,000 by the creation of 2,000,000 1s ordinary shares.

In his review of the year, the chairman (Mr. F. H. McCrea), says that the value of the sales turnover was substantially maintained at the previous year's level in spite of adverse factors. In the earlier part of the year the "credit squeeze" caused an appreciable reduction in the demand for the company's radio, television and electrical products, resulting in a further deterioration of prices, but there was a revival in the later months. In the meantime business from other sources almost offset the loss of sales turnover. Export sales increased. New designs of capacitors and new manufacturing methods are ensuring that the company is able to compete successfully in world markets.

A contract has been placed for a new building at Acton which will enable the company to extend its laboratory and development sections and provide modern canteen and welfare facilities. This will be financed from existing resources. The sales turnover for the first three months of the current year was slightly in excess of last year's figure. Although the tendency is towards still lower selling prices it is expected that a satisfactory result will be achieved.

Electrical Components, Ltd.—As already reported, the group trading profit for 1956-57 amounts to £259,776 (against £252,117), the net profit, after taxation, etc., being £118,727 (£120,024). General and contingencies reserves again receive £50,000 and £10,000, respectively. The final dividend of 7½ per cent makes 12½ per cent for the year on doubled capital (against 25 per cent on the smaller capital) and £120,451 (£138,613) is carried forward.

In his chairman's review, Mr. L. S. Seccombe says that last year there was a further increase in the turnover of the group, making it another record. Higher profits tax on dividend distributions, however, resulted in a slight decrease in the net profit. As regards the current year, the chairman says it is clear from the four months which have elapsed that the pattern of last year has been followed, leading to the hope that the company may achieve equally successful results.

George Kent, Ltd., report a group trading profit for the 53 weeks to 30th March last of £648,474 (against £541,482 for the previous year). To this is added £1,688 investment income (£997 in 1955-56, with £15,000 tax over-provided). After allowing for depreciation, pensions, taxation, etc., the net profit amounts to £160,946 (£161,423). Besides the 12 per cent final dividend a 2½ per cent bonus is paid, making the total distribution for the year 17½ per cent (against 15 per cent). Reserves receive £61,000 (£41,000), £4,776 (£4,580) is applied to debenture redemption and £397,646 (£385,273) is carried forward.

Newton Brothers (Derby), Ltd., report trading profits for the year ended 31st March last of £144,301 (against £161,759 for 1955-56), to which is added £20,163 (£10,682) from investment income. Taxation requires £76,665 (£77,972) and the net profit is £58,668 (£67,135) plus tax refunds and over-provisions of £2,100 (nil). Reserve for replacement of fixed assets receives £25,000 (£9,240) but there are this year no additions to research and development reserve and staff pension fund, which last year received £20,000 and £2,000, respectively. The balance carried forward is £50,026 (£46,052). Meeting: 7th October.

Hilger & Watts, Ltd., are again paying an interim dividend of 3 per cent but on capital increased by a one-for-three "rights" issue. The board states that trading results for the current year to date are satisfactory, and the order book remains at a high level.

The Nigerian Electricity Supply Corporation, Ltd., reports a profit for the year to 28th February last of £144,512, as compared with £141,870 for 1955-56. Taxation requires £70,724 and the net profit is £73,888. General reserve receives £25,000 and the dividend for the year is unchanged at 10 per cent with a final payment of 6 per cent. The balance carried forward is £48,986 (against £46,178 brought in).

Christy Bros., Ltd.—Although the group net profit fell from £30,193 in 1955-56 to £23,930 in 1956-57 the ordinary dividend is maintained at 7½ per cent.

Desoutter Bros. (Holdings), Ltd., have declared an unchanged interim dividend of 12½ per cent.

Engineering Components, Ltd., are paying an unchanged interim dividend of 2½ per cent.

New Companies

Anderson & Co. (Manchester), Ltd.—Registered 18th June. Capital £100. Electrical engineers and contractors, etc. Directors: H. Anderson and Mrs. Jane Anderson. Regd. office: 98, Stretford Road, Manchester, 15.

W. G. Watling, Ltd.—Registered 14th June. Capital £3,000. Electrical engineers, etc. Directors: W. G. A. Watling and Mrs. Winifred R. Watling. Regd. office: 17, Canning Place, Liverpool, 1.

E. E. Hail, Ltd.—Registered 28th May. Capital £100. Electrical contractors, electrical engineers, radio and television dealers, manufacturers and renters, etc. Directors: E. E. Hail and A. J. Cobb. Reg. office: 2, Hambrough Road, Southall, Middx.

Woking Electrical Wholesale Suppliers, Ltd.—Registered 28th May. Capital £100. Directors: O. M. Davey and E. C. Davey. Regd. office: Hascombe, Brooklyn Road, Woking.

Booths (Carlisle), Ltd.—Registered 23rd April. Capital £8,000. To acquire the business of electrical engineer and contractor, etc., carried on by L. R. Booth at Carlisle. Directors: L. R. Booth, Mrs. Lilian Booth and G. B. Booth. Regd. office: 4, 6 and 8, Lonsdale Street, Carlisle.

Dixon & Wintersgill, Ltd.—Registered 17th April. Capital £1,000. Electrical engineers and general electrical installation contractors, radio engineers, motor engineers, etc. Directors: J. Dixon and W. G. Wintersgill. Regd. office: 25, High Street, Morley.

Meadowlight, Ltd.—Registered 30th April. Capital £5,000. Manufacturers of and dealers in fluorescent tubes and fittings, cold cathode control instruments, etc. E. Meadows is the first director. Regd. office: National Bank House, 101-3, Baker Street, W.1.

Broben Electric (Wholesale), Ltd.—Registered 1st July. Capital £100. Manufacturers of and dealers in electrical goods of all kinds, etc. Directors: M. Brown and H. V. Benzimra. Regd. office: 52/54, High Holborn, W.C.1.

Solartron Industrial Controls, Ltd.—Registered 2nd July. Capital £1,000. To undertake and carry out all kinds of research in connection with industrial control and automation, etc. Solicitors: Slaughter & May, 18, Austin Friars, E.C.2.

Bankruptcies

R. Collier, lately trading at 4, The Crescent, Littleham, Exmouth, Devon, as a refrigeration and electrical engineer, formerly trading in partnership with another under the style of Collier & Slater at 4, The Crescent, Littleham, Exmouth, and 108, Victoria Road, Exmouth, as refrigeration and electrical engineers.—Receiving order made 26th July on debtor's own petition. First meeting to-day (Friday) at 12, Pennsylvania Road, Exeter. Public examination 24th September at the Castle, Exeter.

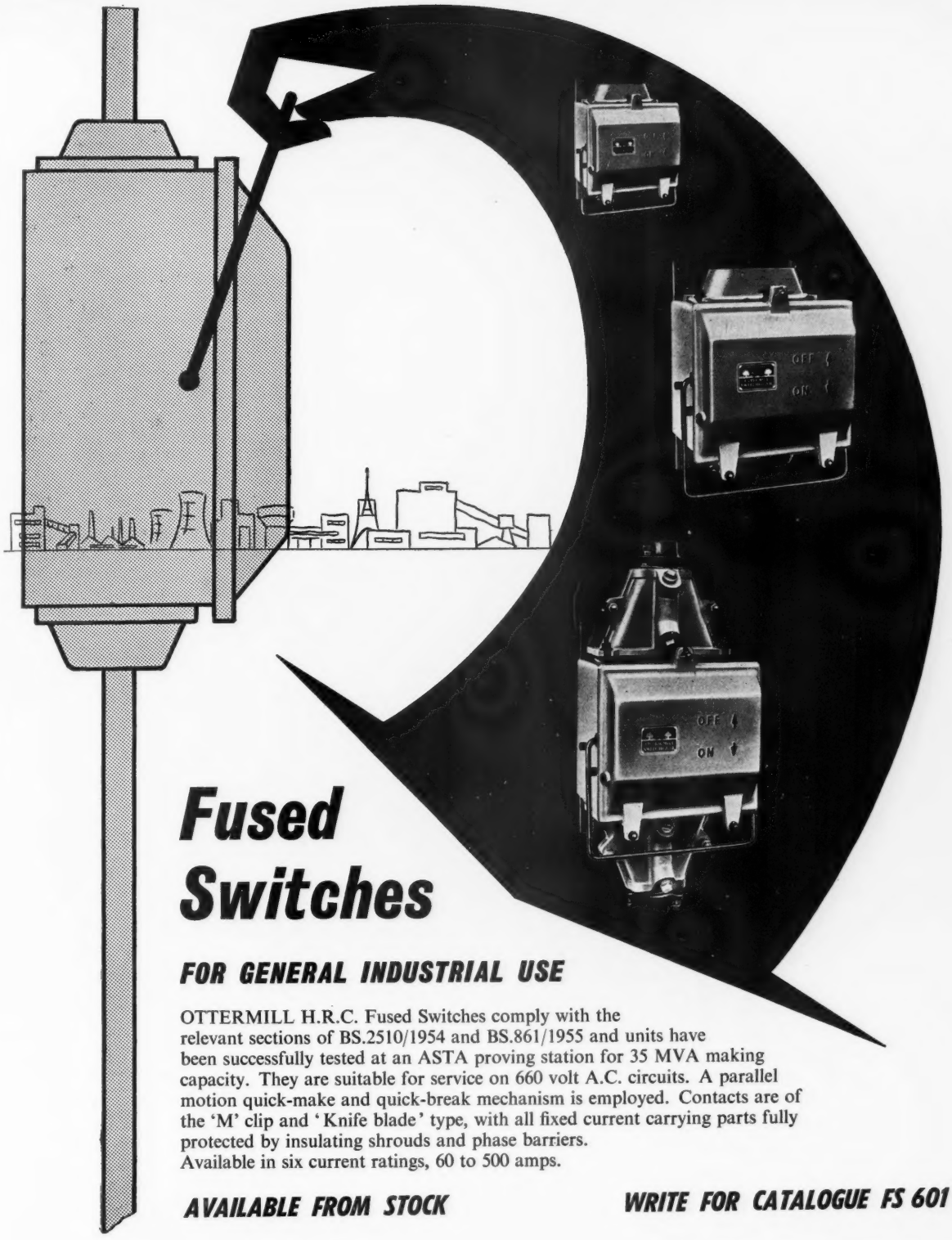
J. J. Glover, 24, Market Place, Reading, electrical contractor.—Application for discharge to be heard on 26th September at The Assize Court, Forbury, Reading.

G. W. Gould, formerly carrying on business at Hillington, Norfolk, as an electrical contractor.—Public examination 12th September at the Court House, London Road, King's Lynn, Norfolk.

H. P. Merken, electrical contractor, 22, Petherton Road, Highbury, London, N.5.—Public examination, 11th October, at Bankruptcy Buildings, Carey Street, London, W.C.2.

P. E. F. Huet, radio and television engineer, trading as Huet & Whatling, 140, Trafalgar Road, Portslade, Sussex.—Third dividend of 9d in the £ payable to-day (Friday) at the offices of A. E. Orbell & Co., 7, Old Steine, Brighton, 1.

A. Le'N. Williamson, Sandringham Hotel, Hope Road, Shanklin, I.O.W., hotel proprietor and electrical engineer.—First and final dividend of 1s 11¼d in the £ payable 5th September at 21, The Avenue, Southampton.



Fused Switches

FOR GENERAL INDUSTRIAL USE

OTTERMILL H.R.C. Fused Switches comply with the relevant sections of BS.2510/1954 and BS.861/1955 and units have been successfully tested at an ASTA proving station for 35 MVA making capacity. They are suitable for service on 660 volt A.C. circuits. A parallel motion quick-make and quick-break mechanism is employed. Contacts are of the 'M' clip and 'Knife blade' type, with all fixed current carrying parts fully protected by insulating shrouds and phase barriers.
Available in six current ratings, 60 to 500 amps.

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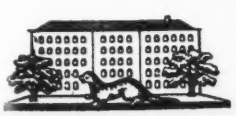

OTTERMILL SWITCHGEAR LTD
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NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) will be obtainable after 28th August from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1953

898. Postmaster General.—Pulse distribution systems. 1st January, 1954. (781916.)

4105. Standard Telephones & Cables, Ltd.—Multiple telegraph signal regenerators. 5th February, 1954. (781901.)

23285/6. Telephone Manufacturing Co., Ltd.—Electromagnetic devices. 24th August, 1954. (781851/2.) 25185. Telephone systems and apparatus. 10th September, 1954. (781853.)

27076. Philco Corporation.—Cathode-ray tubes. 2nd October, 1953. (781911.) 27549. Cathode-ray tube systems. 7th October, 1953. (781912.)

30211. General Railway Signal Co.—Electromagnetic relays. 2nd November, 1953. (782013.)

34900. McIntosh, J. S., and Worboys, F. A.—Electric switch mechanisms. 14th December, 1954. (Cognate application 21138, 20th July, 1954.) (781971.)

1954

381. Philco Corporation.—Cathode-ray tube apparatus. 6th January, 1954. (781913.)

3150. Automatic Telephone & Electric Co., Ltd.—Electrical signalling systems. 27th January, 1955. (781854.)

3433. Standard Telephones & Cables, Ltd.—Sonic delay lines. 5th February, 1954. (Divided out of 781901.) (781902.)

5736. Walton, J. H. D.—Apparatus for testing electrical circuits. 28th February, 1955. (782017.)

10367. British Dielectric Research, Ltd.—Manufacture of electric capacitors. 7th April, 1955. (781763.)

13142 and 14431. Standard Coil Products Co., Inc.—Tuning means operable at ultra high frequencies. 5th and 11th May, 1954. (781857/8.)

13384. English Electric Co., Ltd.—Control gear for steam turbines. 6th May, 1955. (Cognate applications 17955, 18th June, 1954, and 32090, 5th November, 1954.) (781764.)

13723. Philco Corporation.—Cathode-ray tube systems. 11th May, 1954. (781914.)

20816. Siemens Bros. & Co., Ltd.—Mechanism for use as a timing device in the metering of telephone calls. 14th October, 1955. (782019.)

21834. Electric & Musical Industries, Ltd.—Colour television transmitting systems and receivers therefor. 15th July, 1955. (781878.)

29081. General Electric Co., Ltd.—Devices for guiding and holding wire, thread and the like. 11th October, 1955. (781926.)

32609. National Research Development Corporation. — Waveguide/coaxial transmission line transformers. 19th November, 1955. (781882.)

34952. Cass & Phillip, Ltd.—Electrically driven chronometric balance mechanisms. 4th August, 1955. (781781.)

35837. General Electric Co., Ltd.—Electric filter arrangements. 30th November, 1955. (781883.)

36405. Fordham Pressings, Ltd.—Fencing post insulators for supporting electric fencing wire. 15th December, 1955. (781933.)

36469. Philips Electrical Industries, Ltd.—Devices embodying semi-conductors. 16th December, 1954. (781884.)

37827. Philips Electrical Industries, Ltd.—Systems for automatically measuring and controlling physical quantities. 31st December, 1954. (781785.)

1955

822. Jones, A. L. Phipps-.—Recording of radar signals. 11th January, 1956. (781886.)

1066. National Research Development Corporation.—Electrical devices using the Johnsen-Rahbek effect. 11th April, 1956. (781990.)

1467. Marconi's Wireless Telegraph Co., Ltd.—Valve amplifier circuits for phase-amplitude characteristic correction. 28th September, 1955. (781887.)

1509. Elektro-Mechanik Ges.—Control arrangement for an electromagnetic switch. 18th January, 1955. (781934.)

5820. Rushworth, D.—Electrically driven apparatus movable along the ground, for example a land dredger. 22nd May, 1956. (781792.)

6338. General Electric Co.—Manufacture of p-n junction devices. 3rd March, 1955. (Addition to 752457.) (781795.)

10120. General Electric Co.—Electron-discharge devices. 6th April, 1955. (781801.)

18340. Western Electric Co., Inc.—Apparatus for moulding plastic material around wires in the manufacture of switch parts of multi-contact electromagnetic relays. 24th June, 1955. (782000.)

18356. General Electric Co.—Semi-conductor devices and methods for fabricating same. 24th June, 1955. (782035.)

20132. Philips Electrical Industries, Ltd.—Electron microscopes and testing electron lenses. 12th July, 1955. (781815.)

20202. Minister of National Defence of Canada.—Long distance radio communication system. 12th July, 1955. (781816.)

20404. National Cash Register Co.—Electrical apparatus for reducing the access time for a storage register. 14th July, 1955. (781817.)

20586. Vapor Heating Corporation.—Electronically rebalanced temperature sensing bridge. 15th July, 1955. (782001.)

22940. Hazeltine Corporation.—Switching circuit for a two-mode synchronising system in a colour television receiver. 9th August, 1955. (781893.)

23975. Philips Electrical Industries, Ltd.—Transistor amplifiers. 19th August, 1955. (782038.)

24589. General Railway Signal Co.—Electromagnetic relays. 26th August, 1955. (781823.)

25340. Kokusai Denshin Denwa Co., Ltd.—Electric circuits. 2nd September, 1955. (782004.)

26885. General Electric Co.—Method of coating the end turns of stator members for dynamo-electric machines. 20th September, 1955. (782040.)

28402. Telefonaktiebolaget L. M. Ericsson.—Condensers. 5th October, 1955. (782041.)

33057. Telefunken Ges.—Signal generators for multiple frequency transmitters. 18th November, 1955. (782085.)

34570. Standard Telephones & Cables, Ltd.—Electromechanical resonator comprising a magnetostrictive member. 2nd December, 1955. (782008.)

34808. Hazeltine Corporation.—Variable delay system. 5th December, 1955. (782045.)

36341. General Electric Co.—Enclosures for electrical devices. 19th December, 1955. (782046.)

1956

1416. Philips Electrical Industries, Ltd.—Colour television picture tubes. 16th January, 1956. (781838.)

3815. Licentia Patent-Verwaltungs-Ges.—Winding bar for electrical machines. 7th February, 1956. (782048.)

8314. Western Electric Co., Inc.—Apparatus for shaping electromagnetic wave-guides. 16th March, 1956. (782090.)

26606. Automatic Telephone & Electric Co., Ltd.—Electrical signalling systems. 27th January, 1955. (Divided out of 781854.) (781856.)

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 31st August:

A E G. No. 745,215. Class 6. Metallic materials for railway tracks and metallic parts for use in the suspension of trolley wires for electric railways. A E G. No. 745,216. Class 7. Electric generators, electric motors (not for land vehicles), steam engines (not locomotives), steam turbines, gas turbines, compressors, welding machines, electrically-operated machine tools and electrically-operated brakes, being parts of machines. A E G. No. 745,217. Class 10. X-ray apparatus, and parts and fittings. A E G. No. 745,218. Class 11. Incandescent lamps, arc lamps, mercury vapour lamps (not for medical or surgical purposes), and installations for lighting, lamp fittings, and electric ventilating installations. A E G. No. 745,220. Class 17. Materials for electrical insulation.—Allgemeine Elektricitäts-Gesellschaft, Berlin-Grunewald, Germany. Address for service, c/o Matthews, Haddon & Co., 31-32, Bedford St., W.C.2.

COMPTOMETER. No. 765,003. Class 7. Electric motors (not for land vehicles).—Comptometer Corporation, Chicago, U.S.A. Address for service, c/o Stevens, Langner, Parry & Rollinson, 5 to 9, Quality Court, Chancery Lane, London, W.C.2.

RCA (design). No. 753,289. Class 9. Sound recording and reproducing instruments and apparatus, etc.—Radio Corporation of America, New York, U.S.A. Address for service, c/o A. M. & Wm. Clark, Quality House, Quality Court, Chancery Lane, London, W.C.2.

VEBUR. No. 754,514. Class 9. Electro-technical and signalling apparatus, cinematographic and radio apparatus, loudspeakers, etc.—Veb Zeiss Ikon Dresden, Germany. Address for service, c/o Matthews, Haddon & Co., 31-32, Bedford Street, Strand, London, W.C.2.

FINNODE. No. 762,684. Class 9. Electric current rectifiers made of metal.—Westinghouse Brake & Signal Co., Ltd., 82, York Way, King's Cross, London, N.1.

OMEGA (design). No. 763,840. Class 9. Electric flat irons, vacuum cleaners, polishing apparatus for domestic use, welding apparatus, bell systems, electric blowers, electric cigar lighters and transformers.—Veb Electrowarme Altenburg, Altenburg, Germany. Address for service, c/o Matthews, Haddon & Co., 31-32, Bedford Street, Strand, London, W.C.2.

VACETTE. No. 764,522. Class 9. Electric vacuum cleaners.—Pifco, Ltd., Pifco House, Watling Street, Manchester, 4.

No. 764,818 (design). Class 9. Radio, television, telegraphic and telephonic apparatus and instruments; instruments for inspectional control; measuring apparatus, etc.—Cosmocord, Ltd., Eleanor Cross Road, Waltham Cross, Herts.

No. 750,968 (design). Class 11. Electric lighting fittings made of wrought iron.—G. R. Parry, trading as the Black Swan Forge, Black Swan Yard, Silver Street, Wakefield, Yorks.

VAPOLETTE. No. 762,233. Class 11. Electrically heated caps for use in hairdressing and hair drying appliances (not machines).—Indola, N.V., Netherlands. Address for service, c/o E. N. Lewis & Taylor, Berridge Street Chambers, 4, Berridge Street, Leicester.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Acton.—Borough Council. Street lighting. (See this issue.)

Atherstone. — R.D.C. 9th September. Trunk road lighting. (See this issue.)

Australia. — P.M.G's Department, Melbourne. 1st October. Electrical indicating and measuring instruments. (E.S.B. 19450/57. Ten/27438.)*

15th October (extension of closing date from 10th September). Coaxial cable system. (E.S.B. 17461/57. Ten/27067A.)*

Azores.—Federation of the Municipalities of Sao Miguel. Equipment for hydro-electric power stations, transmission lines, substations and distribution networks. (E.S.B. 19778/57. Ten/27513.)*

Belgian Congo.—Ministry of Colonies, Brussels. 5th September. 27 electric refrigerators. (E.S.B. 19714/57. Ten/27537.)*

British East Africa.—Municipal Board of Mombasa. 1st September. Street lighting equipment. (E.S.B. 19614/57. Ten/27463.)*

Chile.—Directorate General of Supply, Santiago. 16th September. Telegraph and telephone cables, 10-15 kVA generating set, telegraph tools and tele-typewriters. (E.S.B. 19162/57. Ten/27453.)*

Durham.—County Council. Electrical installations in schools. (See this issue.)

India.—Government of Mysore Stores Purchase Committee, Bangalore. 31st August. Insulators and tension sets. (E.S.B. 19574/57. Ten/27451.)* 10th September. 33 and 11 kV transmission line materials. (E.S.B. 19575/57. Ten/27467.)*

Controller of Purchase and Stores, Damodar Valley Corporation, Alipore, Calcutta. 31st August. Twelve 132 kV and seven 33 kV outdoor power circuit breakers. (E.S.B. 19641/57. Ten/27473.)*

Damodar Valley Corporation. 13th September. Distribution switchboard. (See this issue.)

Heavy Electricals Private, Ltd., Bhopal. 16th October. 3,000 kW turbo-alternator, two 40,000 lb/hr boilers, coal and ash handling plant, etc. (E.S.B. 19718/57. Ten/27483.)*

India Supply Mission, Washington, D.C. 16th September. 200 2 kW petrol-engine generating sets. (E.S.B. 19951/57I.C.A. Ten/27523.)*

Director General of Supplies and Disposals, New Delhi. 3rd September. Conduits, couplers, tees, saddles, bends, elbows and junction boxes. (E.S.B. 19818/57. Ten/27498.)*

Iran.—Ministry of War, Tehran. 8th October. Central heating installation. (E.S.B. 18967/57. Ten/27429.)*

Iraq.—Development Board and Ministry of Development. 14th October. Transformers, switchgear and accessories for Basrah power station. (E.S.B. 19606/57. Ten/27462.)*

Municipality of Kirkuk. 5th November. Electrical and air conditioning installations, Sirwan Hotel. (E.S.B. 19607-8/57. Ten/27448-49.)*

Italy.—Ministero della Difesa-Aeronautica, Rome. 15th October. Electrical work at an airfield. (E.S.B. 19891/57. Ten/27502.)*

London.—Wandsworth Borough Council. 4th September. Electrical work at Tooting depot. (See this issue.)

New Zealand. — Christchurch Electricity Department. 3rd September. 25 miles of p.v.c. insulated aerial cable. (E.S.B. 19427/57. Ten/27428.)*

Director-General (Stores Division), General Post Office, Wellington. 20th September. Capacitors. (E.S.B. 19430/57. Ten/27459.)*

Northern Ireland.—6th September. Electrical installation at proposed new intermediate school for girls, Somerton Road, Belfast. Colum McNally, consulting engineer, 143, Royal Avenue, Belfast.

Pakistan.—Posts and Telegraphs Department. 3rd September. Jacks for telephone switchboard. (E.S.B. 19709/57. Ten/27492.)* 7th September. H.f. radio telephone equipment. (E.S.B. 19706/57. Ten/27506.)* 10th September. Air conditioning equipment for telephone exchange. (E.S.B. 19773/57. Ten/27491.)* 14th September. Emergency radio sets. (E.S.B. 19707/57. Ten/27490.)*

Skelton and Brotton (Yorks).—U.D.C. Electrical wiring of 12 houses at Skelton. Surveyor, Council Offices, Skelton-in-Cleveland.

South Africa.—Union Tender and Supplies Board. 5th September. Transmitter/receivers, connectors and cable. (E.S.B. 19759/57. Ten/27500.)*

Southgate. — Borough Council. 29th August. Electrically driven metal baling press. Borough engineer, Town Hall, Palmers Green, London, N.13.

Spain.—Hidroelectrica, S.A., Hermosilla 1, Madrid. 30th August. One 60 MVA, 11 kV synchronous compensator and three 230 kV, 5,000 MVA, three-phase circuit-breakers. (E.S.B. 19677/57I.C.A. Ten/27478.)*

Swinton and Pendlebury. — Borough Council. 11th September. Sodium street lighting. (See this issue.)

Workington. — Borough Council. 11th September. Street lighting installation. (See this issue.)

York.—City Council. 23rd September. Three electrically operated main pumps and one sump pump, with motors, automatic switchgear, etc., for Acomb-Naburn main sewerage scheme. Charles J. Minter, city engineer, 7, St. Leonard's Place.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Dagenham.—Highways and Works Committee. Electrical work, Marks Gate Estate (£3,219).—Evans & Shea.

Lancashire. — Education Committee. Renewal of the electrical installation at Lancaster Storey Institute (£5,062).—Simpsons (Lancaster). Renewal of installation at Radcliffe St. Thomas's C.E. (Aided) School (£1,025).—Brindle & Kirby.

Leeds.—City Council. Recommended. Electrical installation work at the new blind persons' hostel at Moortown (£2,320).—Vallance & Davison.

Newcastle-on-Tyne. — Regional Hospital Board. Electrical installation at new treatment rooms at St. George's Hospital, Morpeth (£2,490).—Devereux, Moodie & Co. Electrical work at a new X-ray department and operating theatre at Ashington Hospital (£6,223).—Bonham Electrical & Engineering Co.

Stockport.—Corporation. Recommended. Electrical installation work, Stage 3, at the Town Hall (£3,510).—Coogan & Law.

Stoke-on-Trent.—City Council. Recommended. Electrical installations in 123 houses at Heathcote Road, Longton (£2,822).—H. E. Charlesworth.

Wolverhampton. — Corporation. Recommended. Lift installation at the new retail market (£9,810).—Bennie Lifts.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Alfreton.—Factory for Alfreton Knitting Mills, Ltd.; Warden & Dean, architects, Mansfield Road, Sutton-in-Ashfield.

Amble.—Houses (37), Links estate; T. B. Adamson, U.D.C. surveyor.

Aylesbury.—Factory extension; Mourton, Ltd., Griffin Lane.

Barking.—Dwellings (403), Thames View estate; Carlton Contractors, Ltd., 15, Lingfield Crescent, London, S.E.9.

Bexley.—Technical school for boys, East Rochester Way; C. J. Mann & Son, chartered surveyors, 25, Bedford Row, London, W.C.1.

Bolton.—Bakery, Manchester Road; Warburtons, Ltd., bakers and confectioners, Back-o'-th'-Bank, Bolton.

Bracknell.—Dwellings (310), East Hampstead area; Bracknell Development Corporation, Farley Hall, Binfield.

Coniston. — County secondary school (£96,096); county architect, Fishergate Hill, Preston.

Cuckfield.—Houses (36), Hurstpierpoint, for R.D.C.; A. Hutchings, surveyor, Boltro Road, Haywards Heath, Sussex.

Dorking.—Maisonnettes and flats (36), Goodwyns Farm estate; Clifford Culpin & Partners, architects, 39, Doughty Street, London, W.C.1.

Huyton-with-Roby.—Houses (111), Mosscroft Farm estate; U.D.C. surveyor, Derby Road, Huyton, Lancs.

Merthyr Tydfil.—Dwellings (225), Gurnos; borough surveyor.

Oxford.—Selective secondary school for girls in Gipsy Lane, Headington; city architect.

Pensnett.—Office block; Gibbons Bros., Ltd., Lenches Bridge Works.

Peterlee.—Houses (135), Acre Rigg, for Peterlee Development Corporation; John Twiname, Ltd., builders, Cockermouth, Cumberland.

Redditch.—Rebuilding works, Clarkes (Redditch), Ltd., Prospect Hill; Wheeler & Mansell, Ltd., builders, Lime Street, Evesham.

Seahouses.—Fire station; county architect, Newcastle-on-Tyne.

South Shields.—Occupational centre at Oakleigh and extensions to transport depot (£40,000); J. Reid, borough engineer.

New factory; Elsey & Gibbons, Maxwell Street.

Houses (104), Whiteleas; John Twiname, Ltd., builders, Cockermouth, Cumberland.

Spennymoor.—Houses (149), Middlestone Moor, for U.D.C.; Gray & Partners, architects, Camden Street, North Shields.

Staveley.—Houses (116), Inkersall Green estate; U.D.C. surveyor, Lowgates, Staveley, Chesterfield.

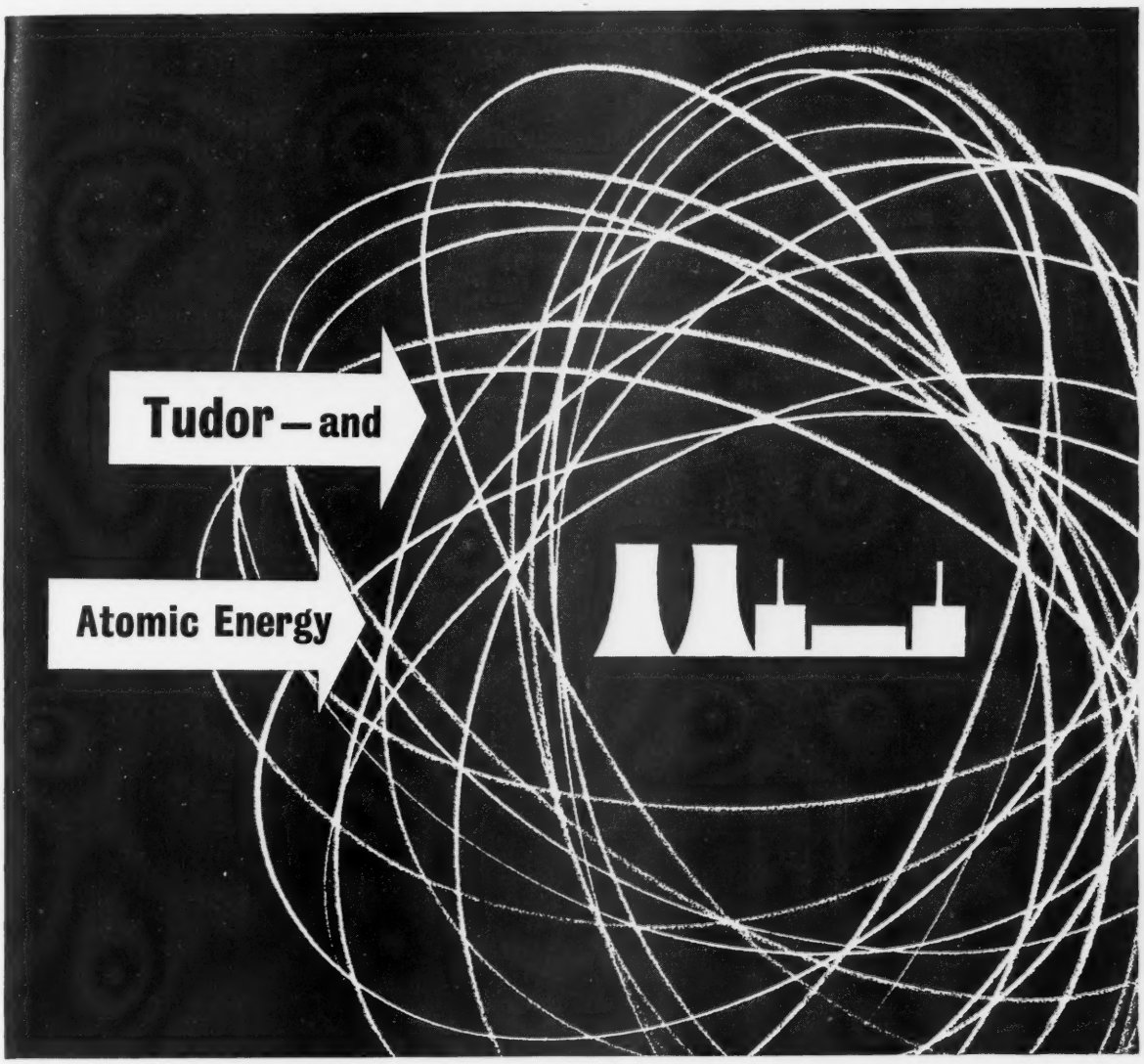
Stockton-on-Tees.—Additions to William Newton Secondary Girls' School; borough architect, 28, The Square.

Tow Law (Co. Durham).—Houses (28), North Cottages; U.D.C. surveyor.

Twickenham.—Flats (24), Staines Road; H. B. Kingston, Ltd., 145, London Road, Kingston-on-Thames.

West Hartlepool.—Fire station; houses (114); A. G. Sinclair, borough architect.

Whitley Bay.—Houses (120), Monkseaton estate; William Stockdale, architect, 73, Howard Street, North Shields.



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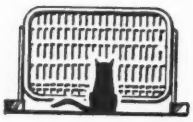

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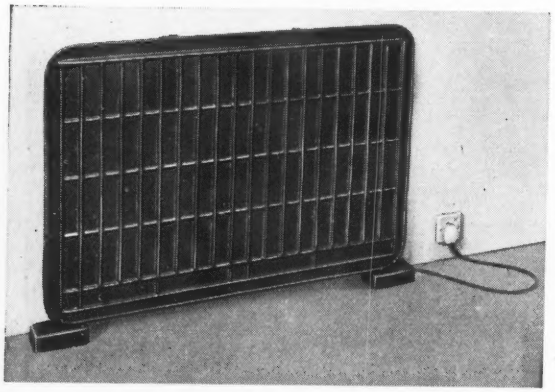

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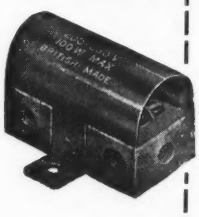

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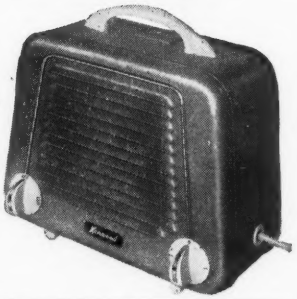

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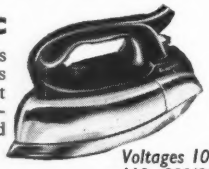

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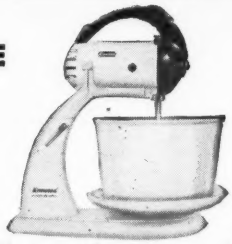

No wonder it's a fast mover. On its streamlined stand or used as a portable for mixing, mashing, whipping or beating jobs anywhere in the kitchen, Minor de Luxe is the best-value-for-money mixer on the market. Voltages 100/125 200/250 (A.C./D.C.)

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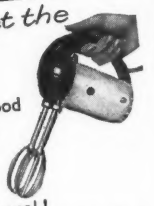

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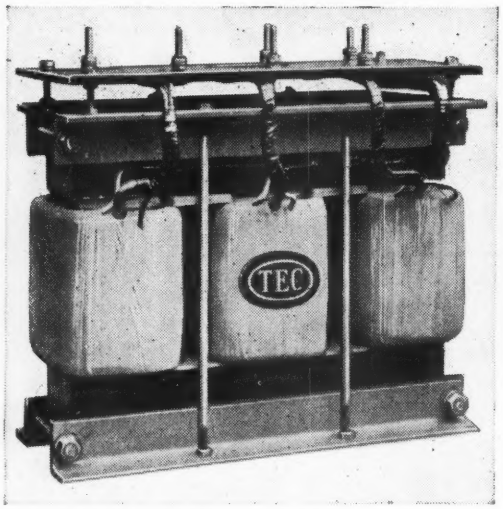

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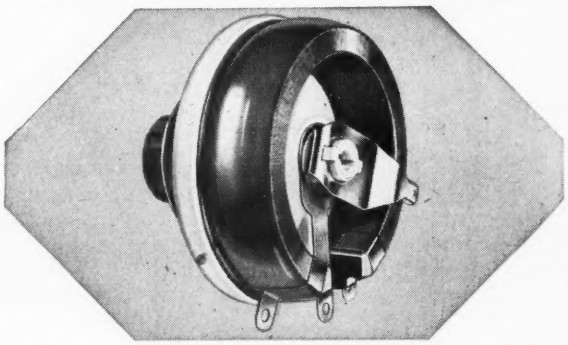

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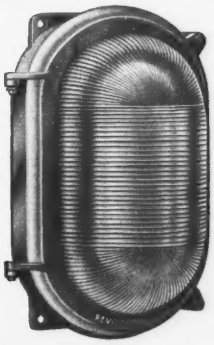

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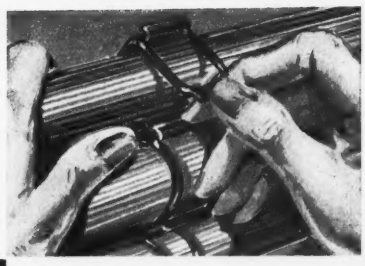

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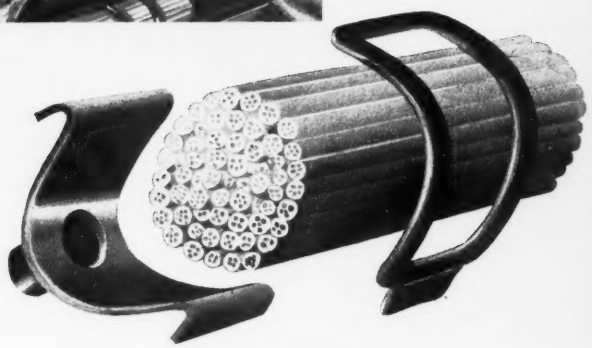

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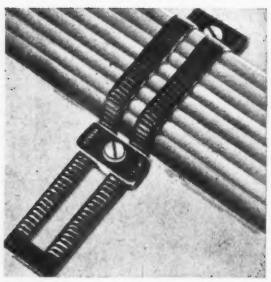

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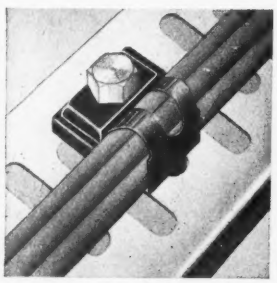
The quickest, most convenient, most versatile and economical cable fixing known. The Insuloid AS Adjustable Saddles accommodate cables of any diameter. type and combination, to provide complete security with reduced time and costs. Made in the highest grade nylon for immense strength. high insulation and anti-corrosion and electrolytic action.



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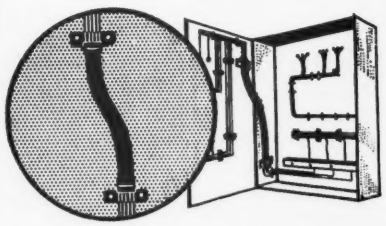

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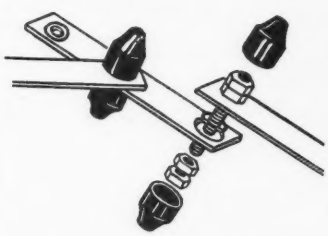

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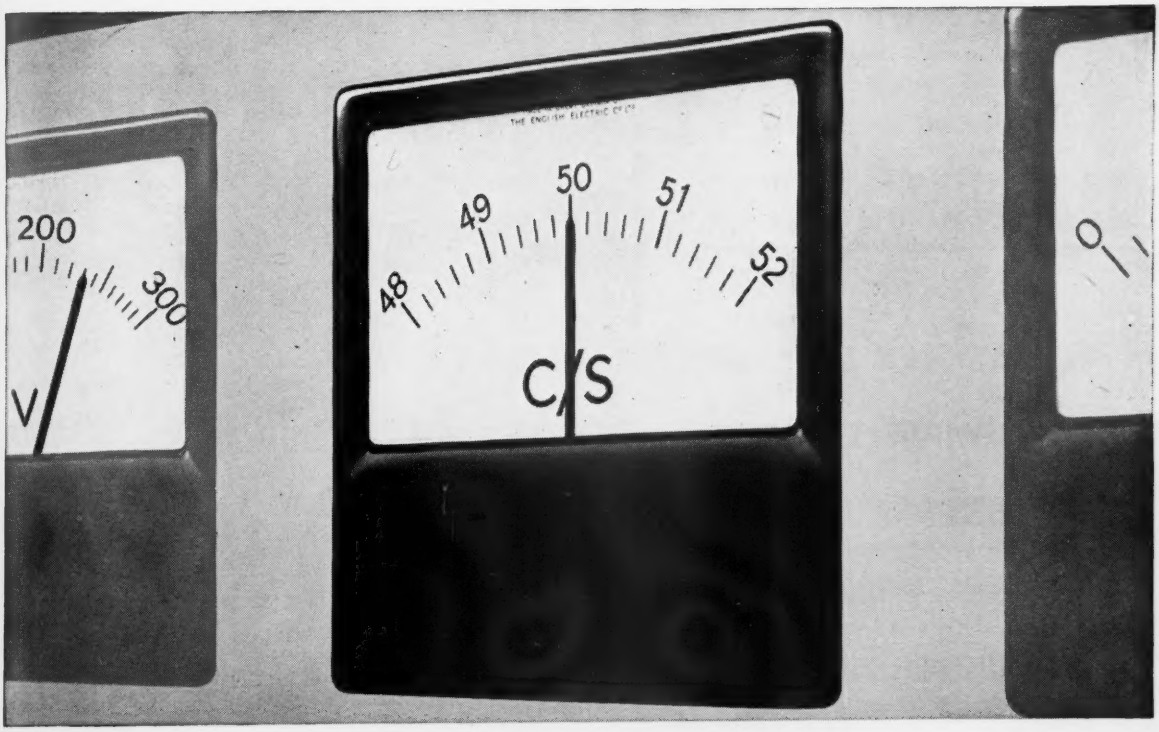

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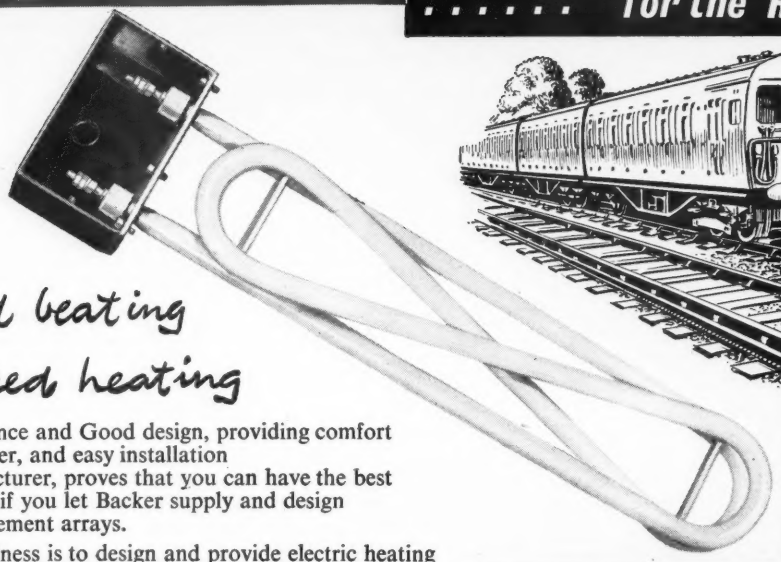

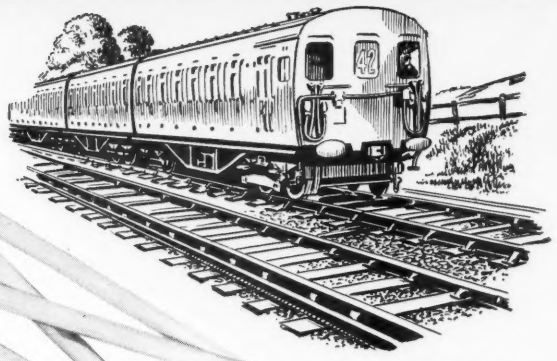

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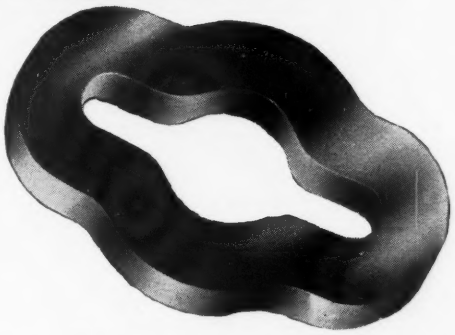

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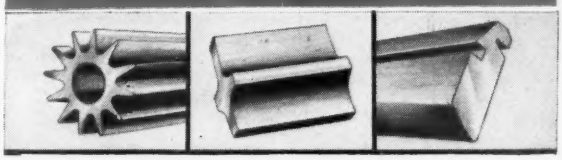

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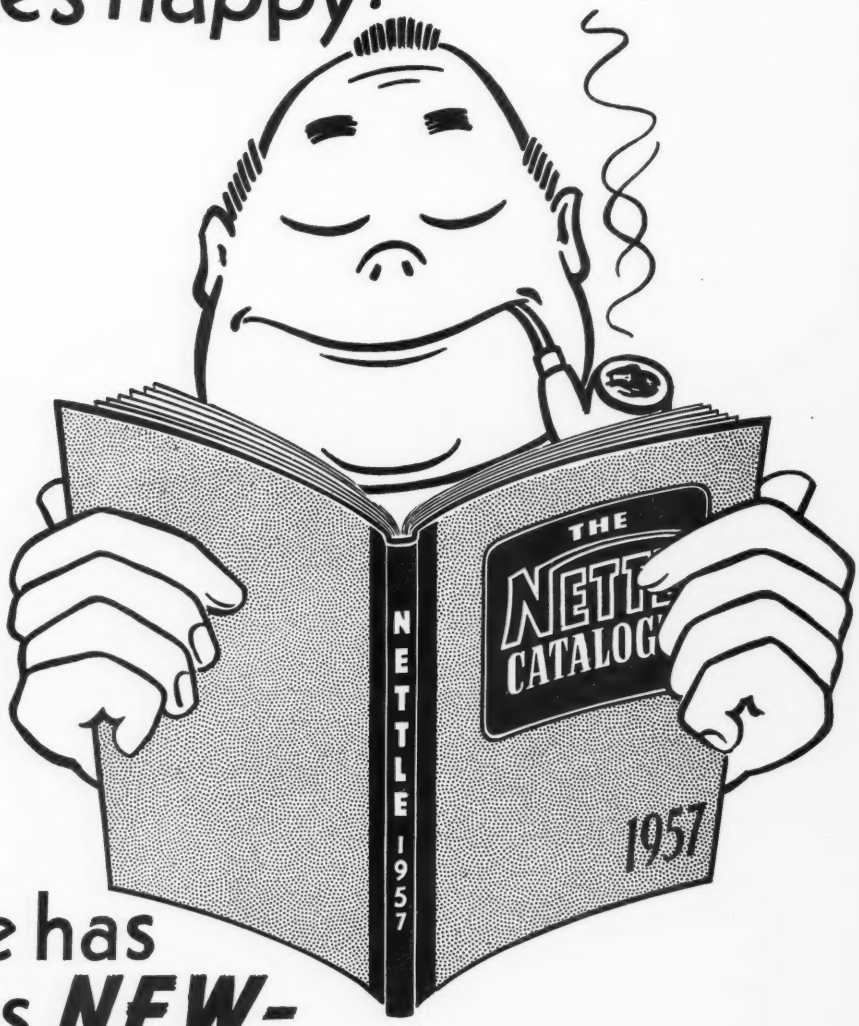

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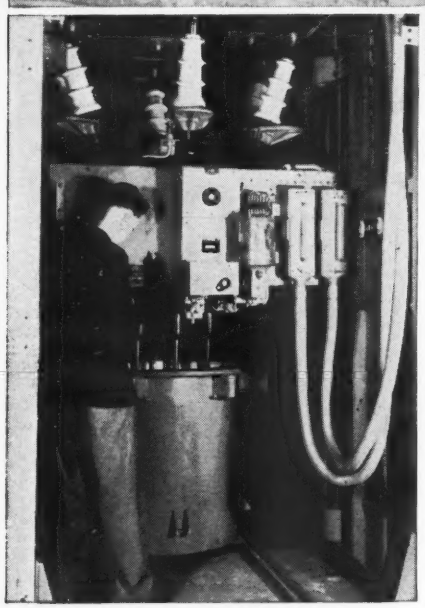

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Above: Seven-panel switchboard on a restricted site in South Wales.

Left: Single unit with tank lowered and breaker in isolated position.

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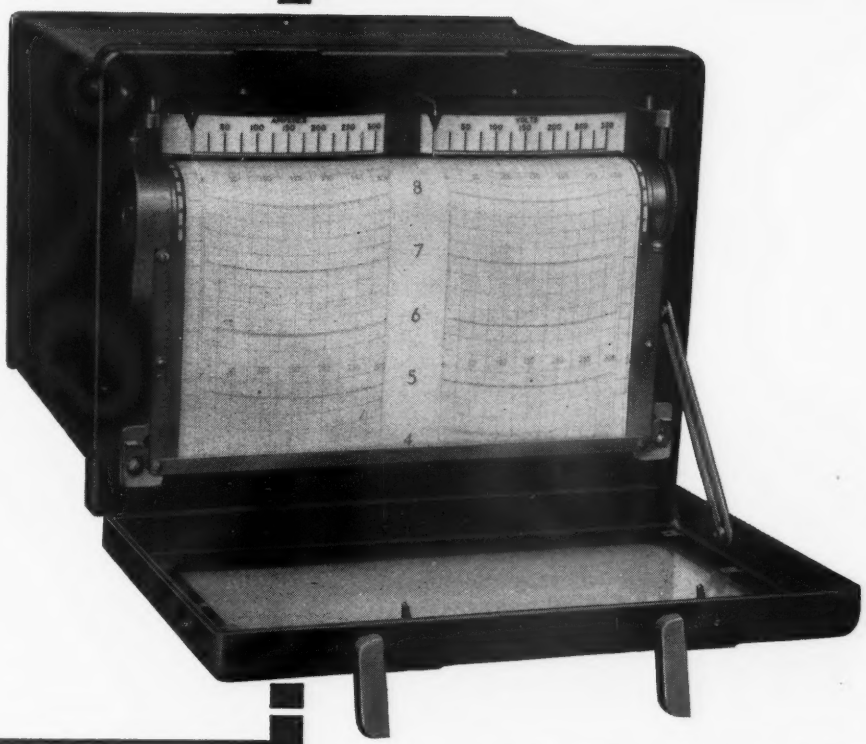

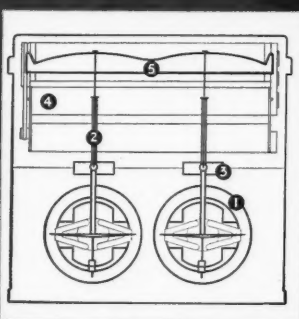

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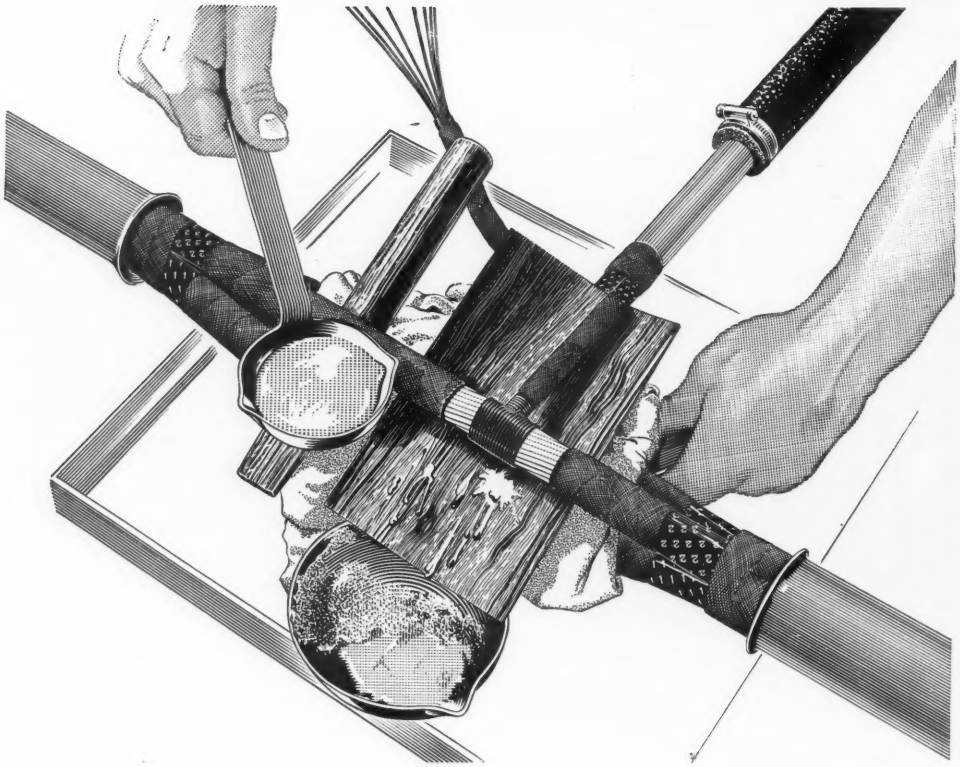

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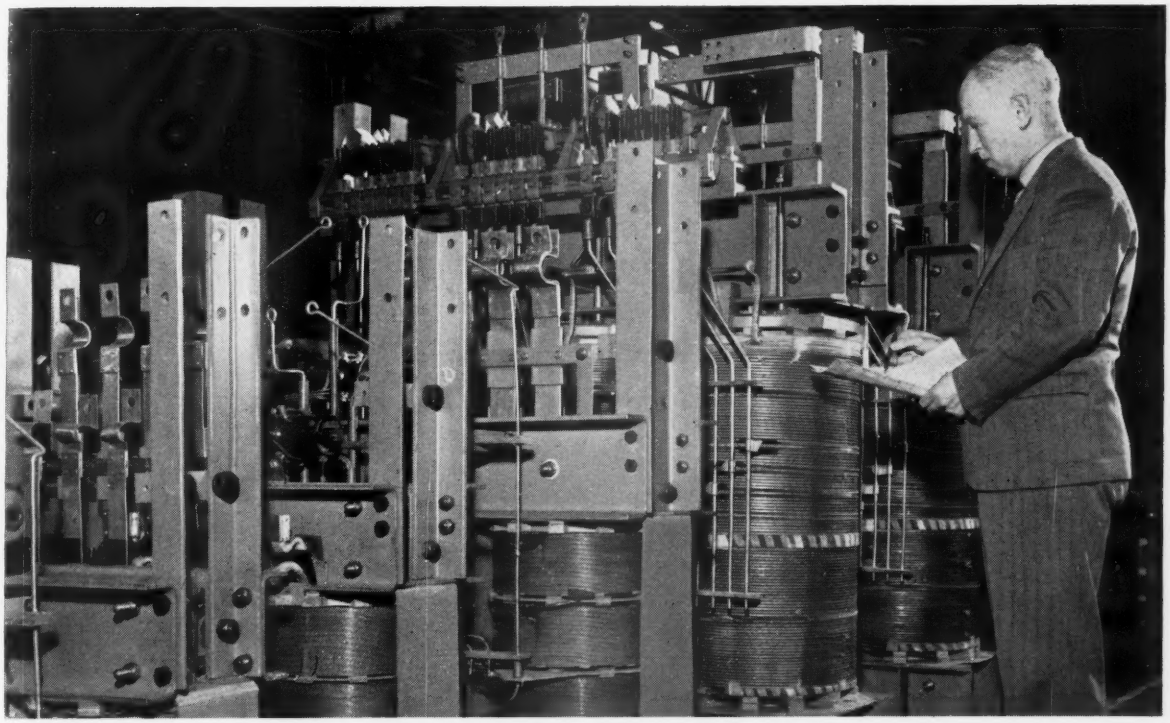

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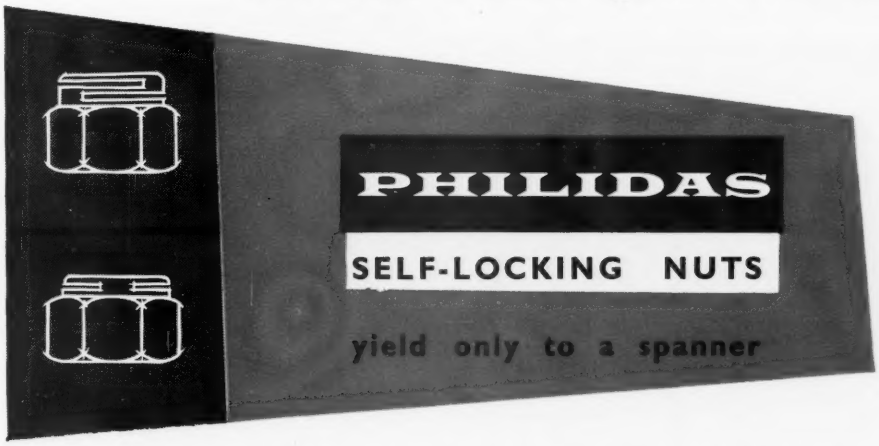

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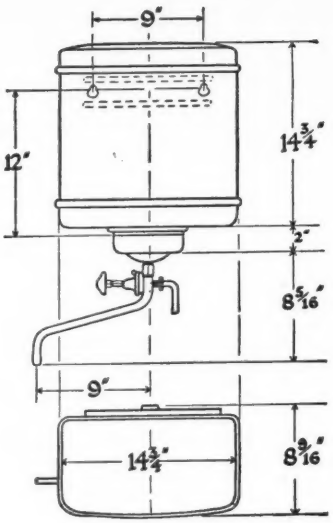
New SANTON FLAT BACK Thermal Storage Heater

2 Gallon Capacity
Standard loading 1.2 kW (2 kW available).
All voltages 200/250 v. A.C.

Choice of Finish
Stove enamelled white or cream on a rustless body.

Choice of Colours
Contrasting coloured bands of either Silver, White, Red, Opaline Green, Light French Blue or Powder Blue.



PRICE £11-17-6
(PLUS £5-11-2 P.T.)

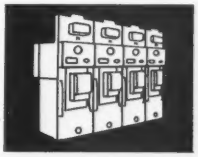
TELEPHONES: Newport 71711. Manchester, Cen. 1394/5
Newton Abbot 1638. Leeds 28762
London, Shepherds Bush 3311/2
Birmingham, Mid. 6421

SANTON LTD. • NEWPORT, MON.

With Switchgear, too—
skill is what makes the difference

The score, which specifies the notes to be played, their speed and rhythm, is but a recipe for music. It is the pianist who makes the music great. His skill is something that cannct be learned from writing: it may be passed on to a brilliant pupil, but only through the keyboard, and only after long practice.

Something almost as odd and subtle turns up in industry. The Americans call it 'know-how', but it often seems as instinctive as a nervous reflex. It is the sum of countless difficulties overcome in the past the solution to which is now taken for granted. It is the reason why there is a difference between one make of switchgear and another that meets the same specification. This difference is the result of years of experience that goes with a name having a long history behind it.



OWNERS OF AN APPROVED ASTA TESTING STATION

Crompton Parkinson LIMITED

In association with Cooke & Ferguson Ltd., Manchester

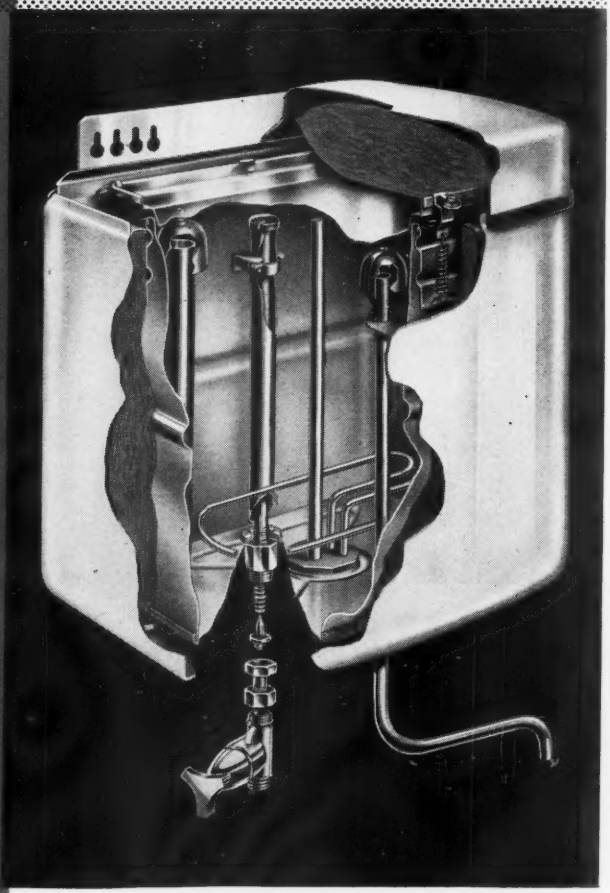
A GOOD NAME FOR SWITCHGEAR

CP ELECTRICAL EQUIPMENT

CROMPTON HOUSE, ALDWYCH, LONDON, W.C.2. TELEPHONE: CHANCERY 3333. TELEGRAMS: CROMPARK ESTRAND LONDON

the NEW Creda Crusader with

Automatic Restrictor Valve!



right-first-time installations

with the new Creda Crusader! thanks to Creda's exclusive Automatic Restrictor . . . the valve that gives the right setting infallibly—without any adjustment!

District and time variations in water supply pressures are all one to the new Crusader. No longer need an adjustable restrictor be set or selected when the heater is installed. The new Crusader automatic flow restrictor needs no setting or adjustment; it controls the flow rate to ensure perfect operation at pressures from 10 to 100 lbs per square inch. It cannot of course cut off the water flow completely. When pressures are below 7 lb per square inch—if the heater is fed from a low level storage tank—the plunger need only be removed from the body of the restrictor to obtain satisfactory operation. With this new Creda refinement the Crusader becomes the easiest-to-install water heater on the market

two more Creda Crusader improvements

SPRING CLIPS now retain the lid of the water container. Easier removal—positive fastening

DE-FURRING without breaking any water joints

stock the improved

Creda Crusader

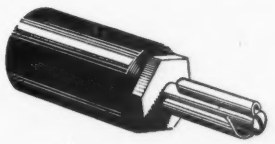
Simplex Electric Company Limited
Creda Works Blythe Bridge Staffordshire

Alperton Depot: Wharf Estate Middlesex

A COMPANY

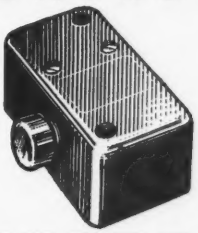
IF YOU NEED TO

CONNECT



PROTECT

CONTROL



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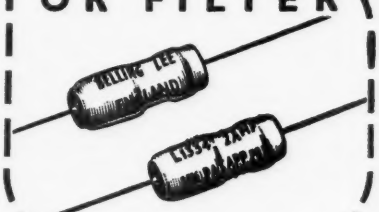

. . . there are "Belling-Lee" components tailored to your requirements by over thirty-five years of "know-how"

Full details of our range of components are available in the "Belling-Lee" General Catalogue. If there is not a copy in your establishment please write to us.

BELLING & LEE LTD
GREAT CAMBRIDGE ROAD, ENFIELD, MIDDX., ENGLAND
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ELECTRONIC COMPONENTS

Switch from this

to this

and step up production . . .

For working within close limits, an Anglepoise is simply indispensable. However good a worker and his eyes may be, he must see the job. This applies in all fine work, drilling, assembling, etc., where instantly adjustable close-to-the-job lighting is a sheer necessity.

Anglepoise throws a clear, concentrated light right on and into the work, not in the operator's eyes, follows the job from any position or angle, degree by degree, at a finger-touch and 'stays put' in any required position—and out of the way when not needed. It needs only a low-powered bulb for high-class results—a big saving on the lighting bill (it can be supplied with a small shade for low voltage systems). Why not learn more about this fine lamp by sending for Booklet ER?

TERRY Anglepoise LAMP

Regd.

Sole Makers: HERBERT TERRY & SONS LTD · REDDITCH · WORCESTERSHIRE

*** A SUGGESTION FOR MACHINE MANUFACTURERS:—**
Why not fit your products with Anglepoise? We will submit samples on approval.

Some of the alternative bases for all models

HT20

PERFORATIONS

IN ALL METALS AND MATERIALS FOR ALL TRADES INCLUDING ELECTRICAL HEATING, VENTILATING, ETC.

W. BARNS & SON (HOLLOWAY) LTD.

Successors to W. BARNS & SON - Established 1860

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Telephone: NORTH 3347-8

Telegrams: PERFORATION HOLWAY LONDON

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MERCURY SWITCH UNITS

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MERCURY SWITCH RELAYS

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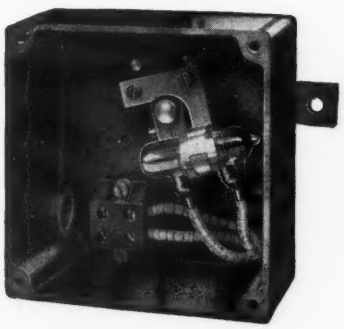

I.A.C. LTD.

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MACLAREN
THERMO-TIME
REGULATOR

an entirely new development

in heating installation control, combining a Thermostat and a Time Clock in one unit. The control regulates the switch-on time of a heating system over infinitely variable conditions of outside temperature and gives the required temperature at the required time inside the building, thus ensuring the maximum economy of fuel with the maximum comfort, without supervision, on any type of installation.

Specialists of long experience in the design and manufacture of

THERMOSTATS

for electricity, gas oil or steam

PRESSURE REGULATORS, FLOAT SWITCHES, ETC.

Robert Maclaren & Co. Ltd.

EGLINTON WORKS, KILBIRNIE STREET, GLASGOW, C.5

Phone: SOUTH 2011/2/3 Grams: "SOCKET, GLASGOW"

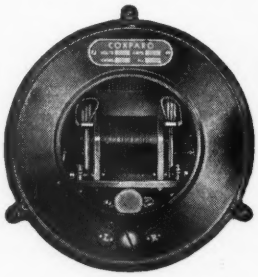
THREADED PLUGS

A wide range of sizes for Conduit and B.S.P. threads

Litholite Plastic Moulders since 1901

LITHOLITE Insulators & St. Albans MOULDINGS LTD.
Sandown Road, WATFORD, Herts. Tel. WATFORD 4494

Automatic VOLTAGE REGULATORS



The COXPARO will "Smooth things out"

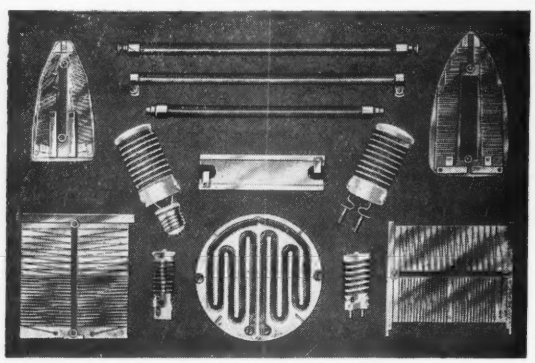
- SUITABLE FOR A.C. AND D.C. MACHINES
- ACCURATE TO ± 1% OR LESS
- SIMPLE EFFECTIVE DESIGN
- COMPLETELY SELF CONTAINED
- CONTROL KNOB PROVIDES ± 10% OF DECLARED VOLTAGE
- INSTALLED IN A FEW MINUTES
- PRACTICALLY NO MAINTENANCE

COX-WALKERS LTD.
NORTH-EASTERN ELECTRIC WORKS
FEETHAMS – – DARLINGTON Phone 2387

dependable ELEMENTS

for every job

Stocked by Leading Wholesalers



THE ELECTRIC ELEMENTS CO.
Tokenhouse Yard, Nottingham
Makers of Elements since 1921

RESISTANCE WIRES

TOPHET

STAINLESS STEEL WIRES

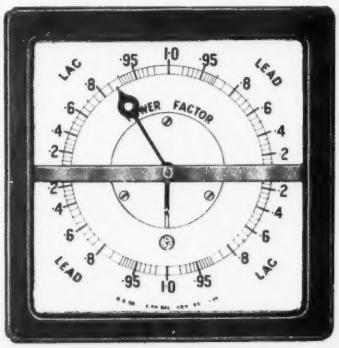
The 'Tophet' range of resistance materials is eminently suitable for use under the most exacting conditions as the physical and mechanical properties always remain constant, ensuring long and efficient service.
Our RESISTANCE HANDBOOK gives complete electrical and physical data regarding 'Tophet' resistance wires, stainless steels and ultra fine wire, as well as particulars of our 'Truflex' thermostatic bimetal.

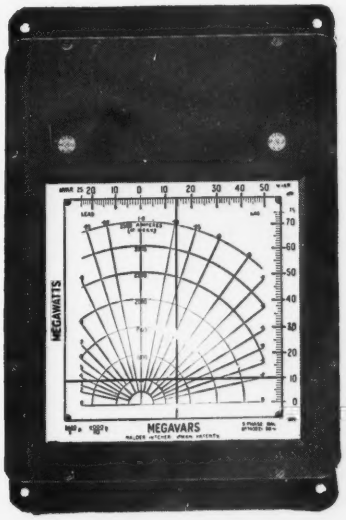
Manufactured by **GILBY-BRUNTON LIMITED**
HEAD OFFICE & WORKS: SEAMILL, MUSSELBURGH, SCOTLAND
Telephone: Musselburgh 2369
LONDON OFFICE: 47 WHITEHALL, S.W.1. *Tel: WHitehall 6058*

NALDERS

FOR HIGH QUALITY AND ACCURACY

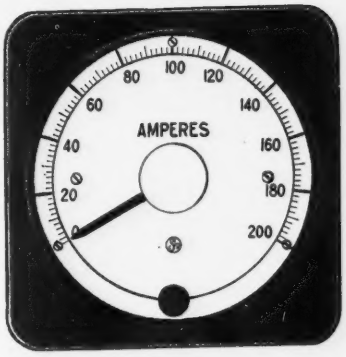
INSTRUMENTS





N.C.S. VECTORMETER

The *only* instrument to give simultaneous readings of Megawatts, Megavars, Amperes and Power Factor of the three-phase system in which it is connected. It shows also whether Power is being "Exported" or "Imported." Indication is by two pointers moving at right angles and in straight lines over a common dial. The Megawatt, Megavar and Ampere scales are each 6 ins. long.



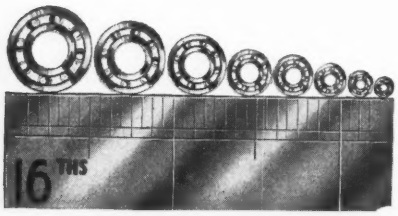
Nalders manufacture a wide range of Electrical Measuring Instruments—indicating, recording, switchboard, portable—high quality being characteristic of every type. All instruments conform to B.S.S.89, cases being of Rectangular, Square, or Round pattern in diecast aluminium or pressed steel, finished bright black stove enamel or other colour to customers' requirements.

NALDER BROS. & THOMPSON LTD., DALSTON LANE WORKS, LONDON E.8

Telephone: Clissold 2365 (3 Lines) *Telegrams:* Occlude, Hack, London.

What's so particular about a Nepticula?

Just this : it is one of the smallest moths in the world, with a wing span of only $\frac{1}{4}$", a body length of about $\frac{1}{8}$" and a head size no bigger than this full stop.
You might think from this that nature is unequalled for perfection in miniature if you did not know about Hoffmann miniature bearings. These remarkable bearings are precision made in a series of sizes from $\frac{1}{2}$" down to 3 m.m. outside diameter and can be supplied to specifications ABEC 3, 5 or 7. They are an essential part of instrument motors, meters, television cameras, and engineering and scientific equipment.



HOFFMANN *precision*

MINIATURE BALL BEARINGS

When miniature perfection has a bearing on it, Hoffmann is the bearing

THE HOFFMANN MANUFACTURING CO. LTD., CHELMSFORD, ESSEX

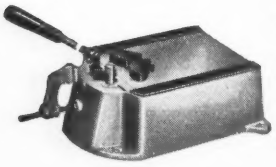
HYDE FOOT-OPERATED WIRE STRIPPER

Strips a wide range of insulated wires and small flexible cables up to $\frac{1}{4}$" outside diameter. Operating in one quick, effortless action, the stripper will not nick or damage wires.

HYDE E-Z WIRE STRIPPER

Used by hundreds of manufacturers, contractors and service agents. Precision stripping with the E-Z saves wasting wire, prevents nicking and protects the user's fingers.

Stripping without teasing



HYDE BENCH-TYPE CABLE STRIPPER

Strips insulation from cables up to $\frac{3}{4}$" outside diameter, no splaying, no nicking, and one single movement does the whole job quickly and cleanly.

The days of clumsy stripping with knife or pliers have gone—the efficient, modern method is to use HYDE wire and cable strippers. Adjustable stops control length of strip. For greater production and perfect results, without skill or experience, HYDE strippers are essential.

Obtainable from all good Tool Dealers or directly from the makers:

J. B. HYDE & CO. LTD.
Altrincham Road
WYTHENSHAWE, MANCHESTER.
Telephone: WYThenshawe 2850.
Telegrams: "Braiding, Wythenshawe"

Amalgam RESMACT—
A supremely efficient solder

Write to us for a sample of this A.I.D. approved, activated solder wire with non-corrosive RESINACT core. It is specially designed for all electrical work and is available to any specification in sizes from 4-22 W.G.
We are specialists in all forms of fusible alloys.

GREY & MARTEN LTD
ESTABLISHED 1833
CITY LEAD WORKS · SOUTHWARK BRIDGE · S.E.1
Telephone: HOP 0414 Telegrams: Amalgam, Sedist, London
and at Birmingham and Ipswich

Smithlite
SUPER WONDER BATTEN

9 STAR FEATURES

- Now available in four sizes
- Fitted with standard "Smithlite" Supa-Choke
- Fully compounded and cased
- 5 ft. 80 watt and 4 ft. 40 watt chokes are tapped for 200/250 volts supply
- Entirely new design
- All sizes individually packed and the 5 ft. 80 watt in a strong fibreboard carton
- Constructed from rustproof steel and stove enamelled white
- Simple clip-on rigid lamp holder covers
- Already assembled, and wired for immediate installation

5 ft. 80 w. only £4 . 3 . 0
4 ft. 40 w. „ £3 . 14 . 0
3 ft. 30 w. „ £3 . 11 . 6
2 ft. 20 w. „ £3 . 1 . 0
The above prices plus 5%
PRICES DO NOT INCLUDE LAMP

HERMAN SMITH SMITHLITE LTD
EMPIRE WORKS • DUDLEY • WORCS
TELEPHONE: DUDLEY 3178 (3 LINES)
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THIS IS THE TRADE MARK
FDS REGD
WHICH DENOTES THE BEST QUALITY IN
INSULATED WIRES AND STRIPS

F.D.SIMS LIMITED
P.O. Box 8 Hazelhurst Works
RAMSBOTTOM, Manchester
Telephone: Ramsbottom 2213/4/5
Telegrams: "SIMS, Ramsbottom"
London Office: 95 Westmoreland Rd., BROMLEY, Kent
Telephone: RAVensbourne 2805

S47

Lionel Robinson
& Co. Ltd.
DISTRIBUTORS OF
WOLF ELECTRIC TOOLS

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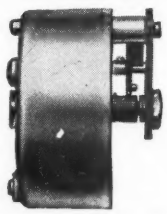
Accrington 2774

7 Springfield Street Warrington
Warrington 2390

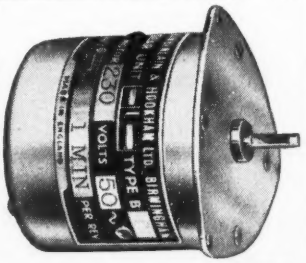
161-163 Eldon Street
Preston
Telephone—Preston 57975-6

4 Staple Inn
London, W.C.1
Telephone - - HOLborn 6322



TYPE K

Synchronous Timing Units



TYPE B

TYPE BD

SPEED RANGES
200 R.P.M. — 1 REV. PER WEEK

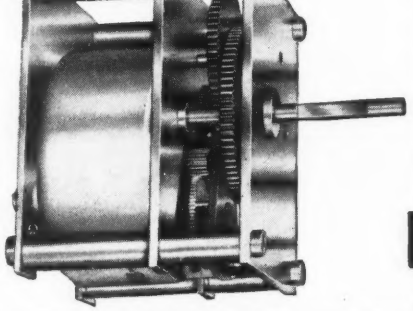
FOR TECHNICAL DATA
SEE CATALOGUE SECTION 12500

TYPE BE

Chamberlain & Hookham Ltd

BIRMINGHAM **Telephone: MIDLAND 0661 & 0662**

LONDON OFFICE: MAGNET HOUSE, KINGSWAY, W.C.2



TYPE BK

TYPE B, BD, BE, and BK GEAR UNITS
K TYPE MOTORS

Classified Advertisements

CLASSIFIED advertisements are PREPAID at 3/6 per line (approx. 6 words) per insertion. Where an advertisement includes a Box Number there is an additional charge of 1/-.

DISPLAYED CLASSIFIED:—48/- per inch. Cheques and Postal Orders should be crossed and made payable to ELECTRICAL REVIEW PUBLICATIONS LTD.

SERIES DISCOUNTS for consecutive insertions:—13, 5%; 26, 10%; 52, 15%.

SITUATIONS WANTED:—Three insertions under this heading can be obtained for the price of two if ordered and prepaid with the first insertion.

REPLIES to Box Numbers should be addressed to the Box Number in the advertisement, c/o ELECTRICAL REVIEW, Dorset House, Stamford Street, London, S.E.1, but if not to be delivered to any particular firm or individual they should be accompanied by instructions to this effect, addressed to the Manager of the ELECTRICAL REVIEW. Replies in such cases cannot be returned. The name of an advertiser using a Box Number will not be disclosed.

ADVERTISEMENTS are accepted up to First Post on Monday of the week of issue and should be addressed to ELECTRICAL REVIEW, Classified Advertisement Department, Dorset House, Stamford Street, London, S.E.1.

Original testimonials should not be sent with applications for employment

OFFICIAL NOTICES, TENDERS, ETC.

ATHERSTONE RURAL DISTRICT COUNCIL

Parishes of Atherstone and Hartshill

Street Lighting on Trunk Roads A.5 and A.47

TENDERS are invited for the supply, delivery and erection of street lighting equipment on the above roads. The scheme comprises 26 Fluorescent and 18 Sodium Fittings on the A.5 and 12 Sodium fittings on the A.47, all on steel columns and to Group A standards

The form of tender, specification and bills of quantities may be obtained from Mr. D. C. Smith, Engineer and Surveyor, Council Offices, Atherstone, on receipt of a deposit of £2 2s., which will be returned on receipt of a bona fide tender, not subsequently withdrawn. Plans may also be viewed at the same office.

The acceptance of the tender is subject to the approval of the Minister of Transport and Civil Aviation.

The Council does not bind itself to accept the lowest or any tender, nor to defray the cost incurred by any person in the preparation thereof.

Tenders must be received by the undersigned not later than 12 noon on 9th September, 1957, in plain sealed envelopes endorsed "Street Lighting, Routes A.5 and A.47."

G. CARLYON MAY,
Clerk of the Council.

Council Offices,
Atherstone, Warwickshire. 7186

BOROUGH OF WORKINGTON

Street Lighting, Town Centre

TENDERS are invited for the erection of 26 Class A Concrete Columns and 16 Class B Concrete Columns with 140 and 85-watt sodium lamps.

Specification and forms of tender can be obtained from the Borough Surveyor, Stoneleigh, Park End Road, Workington.

Tenders are to be returned to the undersigned, in the envelopes provided, not later than 12 o'clock (noon) on Wednesday, 11th September, 1957.

The Corporation do not bind themselves to accept the lowest or any other tender.

RUSSELL C. PHARAOH,
Town Clerk.

Town Hall,
Workington.
12th August, 1957. 7140

The office of

DAMODAR VALLEY CORPORATION

Anderson House, Alipore, Calcutta 27, India, invites tenders for the following:

Supply of Low Tension A.C. (415 volts) and D.C. (250 volts) Distribution Switchboard.

Tender specifications PE-Spec-21, which are for sale per copy at 12s. plus £1 17s. 6d. for air parcel charged, are obtainable direct from the Controller of Purchase and Stores, Damodar Valley Corporation,, Anderson House, Alipore, Calcutta, 27, India.

Tenders are to be returned direct to the above address for opening by 3 p.m. on the 13th September, 1957. Specimen copy of above specifications is on view at India Store Department, Government Building, Bromyard Avenue, Acton, London, W.3. Reference S.1)66/57/AVH/ENG.2. 7227

DURHAM COUNTY COUNCIL

TENDERS invited for P.C. Items at the following new schools:—

Barnard Castle New Grammar Technical School: Electrical installation.
Sedgefield New Modern School: Electrical Installation.
Sherburn New Modern School: Electrical Installation.

Applications for further details to County Architect, South Street, Durham, not later than 28th August, 1957.

J. K. HOPE,
Clerk of the County Council.

Shire Hall,
Durham. 7228

BOROUGH OF SWINTON AND PENDLEBURY

Street Lighting

TENDERS are invited for the supply and erection in various parts of the district of 50 Concrete Lighting Columns on estate roads with Sodium Lanterns and all auxiliary equipment. Further details from Borough Engineer and Surveyor, Town Hall, Swinton, Lancs.

Closing date for receipt of tenders, 11th September, 1957.

The Corporation do not bind themselves to accept the lowest or any tender.

J. W. BLOMELEY,
Town Clerk. 7185

METROPOLITAN BOROUGH OF WANDSWORTH

Electrical Works, Tooting Depot

TENDERS are invited for the supply and installation of 32 2-kW Infra-red Electric Heaters, together with installation of sub-main and attendant sub-circuits at Tooting Depot.

Tender documents, obtainable from the Borough Engineer at the undermentioned address, must be returned by noon on Wednesday, 4th September, 1957.

R. H. JERMAN,
Town Clerk.

Municipal Buildings,
Wandsworth,
London, S.W.18. 7141

BOROUGH OF ACTON

Street Lighting Columns

THE Council invite tenders for the supply and erection of Steel Electric Lighting Columns and Equipment on approximately 14 miles of Class A highways.

Forms of tender may be obtained from the Borough Engineer and must be returned to the Town Clerk, Town Hall, Acton, London, W.3, by 25th September, 1957. 7226

SITUATIONS VACANT

FOR CANADA

ELECTRICAL DESIGNERS, Senior and Junior, required by progressive and expanding Canadian manufacturer of induction and synchronous machines, fractional h.p. to 2,000 kW and D.C. up to 250 kW.

All positions are pensionable and carry an attractive health and insurance scheme. Salaries on Canadian scale and commensurate with experience and qualifications. Experience need not cover the full range indicated.

Applicants should give full details of age, training and experience, together with copies of testimonials, and should apply initially to—Box 9094.

SOUTH EASTERN ELECTRICITY BOARD

DISTRICT COMMERCIAL ASSISTANT, Crawley and Horsham District.

Salary £500 × £20 to £600 p.a. under N.J.C. Grade 1. Superannuable.

Applicants should have experience in dealing with consumers' enquiries, supply matters, tariffs, a sound general knowledge of domestic electrical appliances, agricultural and commercial supplies.

Applications, naming two referees, to L. J. Simmons, M.I.E.E., A.M.I.I.A., District Manager, SEEBOARD, 32/40, North Street, Horsham, by 4th September, 1957.

SENIOR SHOWROOM ASSISTANT, West Kent District.

Salary within range £680 × £20 to £740 per annum, plus London weighting, according to experience, under N.J.C. Grade 3. Superannuable.

Applicants should have had considerable experience in the day-to-day operation of a busy showroom, the co-ordination of staff activities, the planning of window displays, the control of staff, and the provision of an efficient sales activity, together with service and advice to consumers on all supply matters.

Applications, naming two referees, on forms from P. S. Watson, M.I.E.E., West Kent District Manager, SEEBOARD, 270, High Street, Orpington, Kent, by 4th September, 1957.

DISTRICT COMMERCIAL ASSISTANT, Eastbourne.

Salary £615 × £20 to £675 p.a. under N.J.C.2. Superannuable. The person appointed will be required to deal with consumers' enquiries and to give advice on supply matters, tariffs, appliance sales and electrical installations for all classes of domestic and commercial consumers.

Applicants should be thoroughly conversant with all types of electrical appliances and installations and be able to quote for contracting work.

Applications, naming two referees, on forms from J. E. Winborne, District Manager, SEEBOARD, Electric House, Grove Road, Eastbourne, by 4th September, 1957.

LADY DEMONSTRATOR, West Kent District.

Salary £500 × £20 to £600 p.a. plus London weighting under N.J.C. Grade 1. Superannuable.

Applicants should possess a recognised diploma or certificate in domestic science, also E.A.W. Certificate. The successful applicant will be required to conduct lectures and demonstrations, advise consumers, and generally assist in service centres.

Applications on forms from P.S. Watson, M.I.E.E., West Kent District Manager, SEEBOARD, 270, High Street, Orpington, Kent, by 4th September, 1957.

DISTRICT ENGINEER, Herne Bay/Canterbury District.

Salary under N.J.B. Class E, Grade 3, £1,065 × £25 to £1,140. Superannuable.

Applicants should be fully qualified, possess a sound general education and technical education and be experienced in the design, construction and maintenance of H.V. and medium pressure overhead and underground distribution systems. The appointment will involve standby duties.

Applications naming two referees to A. J. Hunt, Esq., Joint District Manager, SEEBOARD, 65, Mortimer Street, Herne Bay, Kent, by 28th August, 1957.

A. L. BURNELL,
Secretary.
7219.

Situations Vacant (continued)

CENTRAL ELECTRICITY AUTHORITY

East Midlands Division

APPLICATIONS are invited for the following appointments in this Division :—

COAL AND ASH HANDLING ENGINEER, WILLINGTON "A" POWER STATION
(Vacancy No. 67/57/ER).

The successful applicant will be required to supervise the operation of the coal and ash handling plant at this station. He will also be responsible for organising the coal and fuel oil deliveries and for the disposal of ash.

Experience of similar duties in a P.F.-fired station, and of the control of staff, will be an advantage.

The salary will be in accordance with Class K, Grade 9 (£995-£1,055 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 11th September, 1957.

SECOND ASSISTANT ENGINEER (Mechanical), GENERATION (Construction) DEPT., CASTLE DONINGTON POWER STATION SITE
(Vacancy No. 142/57/ER).

Applicants should have had a fundamental training in mechanical engineering, including workshops, together with experience in the manufacture and erection of heavy mechanical plant as installed in a modern power station. Experience in the operation and maintenance of H.P. boiler plant will be an advantage. It would be an advantage for candidates to have a university degree or equivalent qualification in mechanical engineering.

The salary will be in accordance with Class AX/EX, Grade 2 (£1,145-£1,410 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 11th September, 1957.

FOURTH ASSISTANT ENGINEER, COVENTRY TRANSMISSION SECTION OFFICE
(Vacancy No. 144/57/ER).

Applicants should have experience of the maintenance and operation of E.H.T. overhead lines, transformer and switchgear.

Preference will be given to candidates with qualifications leading to Corporate Membership of the Institution of Electrical Engineers.

Salary will be in accordance with Class AX/EX, Grade 5 (£810-£1,035 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 11th September, 1957.

These appointments will be pensionable within the provisions of the Central Electricity Authority and Area Boards (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT, which may be obtained from the Divisional Establishments Officer, Central Electricity Authority, East Midlands Division, P.O. Box 25, Barker Gate, Nottingham, and should be returned to the undersigned by the date stated. Please quote vacancy number.

L. F. JEFFREY,
Divisional Controller.
7188

LONDON TRANSPORT

invites applications for post of EQUIPMENT ENGINEER to control section of Development Division of department of Chief Mechanical Engineer (Railways), Acton, dealing with design and development of all items of equipment used on Executive's rolling stock traction motors and control gear, brakes, air-operated doors and other auxiliary equipment.

Qualifications : a detailed knowledge of equipment involved, with preferably some knowledge of traction motor and motor generator design and characteristics ; a general knowledge of the construction of railway rolling stock advantageous ; membership of one of the senior engineering institutions ; an engineering degree in electrical subjects.

Salary range £1,210 to £1,420. Free travel. Medical examination. Contributory superannuation scheme after probation.

Please apply within seven days to Recruitment and Training Officer (F/EV.650), London Transport, 55, Broadway, London, S.W.1. 7204

CIVIL AND ELECTRICAL ENGINEERS

required by

CITY OF WINNIPEG HYDRO-ELECTRIC SYSTEM.

Permanent positions in Winnipeg, Manitoba, Canada.

Graduation from a recognised University or College essential.

CIVIL ENGINEERS

for design, construction and maintenance of dams, reinforced concrete buildings and steel structures.

Salary range $375.00 to $590.00 per month.

ELECTRICAL ENGINEERS

for design and construction of electric utility generation, transmission and substation equipment.

Salary range $375.00 to $524.00.

ELECTRICAL ENGINEER

for utility operation and maintenance work.

Salary range $375.00 to $471.00.

Salary within range according to experience and qualifications.

Any qualified engineer emigrating to Western Canada interested in any of the above positions, please apply to

PERSONNEL SUPERVISOR,
CITY HYDRO,
55, PRINCESS STREET,
WINNIPEG, 2, MANITOBA.

Please give full details as to education, qualifications, experience, age, salary expected, and probable date of availability.

7108

YORKSHIRE ELECTRICITY BOARD

No. 4 (Leeds) Sub-Area

SECOND ASSISTANT ENGINEER (Operation and Maintenance). Applicants should have experience in the operation and maintenance of equipment at voltages up to 33 kV on a large urban underground system and for a rural overhead system up to 66 kV.

Corporate Membership of the Institution of Electrical Engineers or equivalent qualification is required.

The successful applicant will be required to assist in all matters affecting policy for the operation and maintenance of the Sub-Area networks.

Salary N.J.B. Class L, Grade 7, £1,235/£30/£1,325 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 4 (Leeds) Sub-Area, Yorkshire Electricity Board, Bramhope, near Leeds, not later than 5th September, 1957.

No. 5 (Wakefield) Sub-Area

SENIOR DRAUGHTSMAN (Electrical)—2 Posts.

Applicants should have had a good general and technical education at least to O.N.C. standard and have had drawing office experience in the theory, design, layout and construction of substations of voltages up to and including 66 kV, and be able to prepare to instructions drawings for new designs and modifications to existing layouts. Experience in the preparation of wiring diagrams for electrical equipment will be an advantage.

Salary N.J.B. Schedule D, Grade 5, £760/£20/£860 per annum.

ENGINEERING DRAUGHTSMAN (Electrical).

Applicants should have a good general and technical education to at least O.N.C. standard and have had drawing office experience in the layout and construction of substations of all voltages and wiring diagrams for electrical equipment.

Salary N.J.B. Schedule D, Grade 6, £595/£20/£715 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 5 (Wakefield) Sub-Area, Yorkshire Electricity Board, 1a, Denby Dale Road, Wakefield, not later than 5th September, 1957.

No. 7 (Grimsby) Sub-Area

SCUNTHORPE DISTRICT.

SENIOR SERVICE CENTRE ASSISTANT.

Applicants should have experience in service centre work, including the sale of electrical appliances, hire purchase agreements, handling of enquiries, and must be capable of advising consumers on any matter relating to the use of electricity in their homes. Some experience of window display will be an advantage.

Salary N.J.C. Grade 3, £680/£20/£740 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 7 (Grimsby) Sub-Area, Yorkshire Electricity Board, Moss Road, Grimsby, not later than 5th September, 1957. 7220

CENTRAL ELECTRICITY AUTHORITY

Midlands Division

SECOND ASSISTANT ENGINEER is required in the System Development Section of the Technical Department at Headquarters, Moseley, Birmingham. N.J.B. service conditions, superannuable appointment, salary within Schedule B, Grade 2, commencing at a point commensurate with qualifications and experience within the range £1,145-£1,410 per annum.

Applicants should possess an engineering degree or other qualifications equivalent to Graduate I.E.E., and should have had practical training either in the supply industry or with a switchgear manufacturer. They should also have held a position of responsibility involving transmission system planning, and should have a sound knowledge of the calculations involved, the design and operation of such systems.

Apply, quoting the vacancy number 620MD on form AE6, available from the Establishments Officer, 53, Wake Green Rd., Moseley, Birmingham, 13, by 12th September, 1957. 7167

CENTRAL ELECTRICITY AUTHORITY

London Division

APPLICATIONS are invited for the following superannuable posts. Conditions of service in accordance with N.J.B. Agreement, Schedule A or B. Salary includes London allowance. Qualifications entitling to Graduate Membership of the I.E.E. or I.Mech.E. for posts (a) and Corporate Membership for posts (b) an advantage.

(a) ASSISTANT ENGINEER (Shift), BARKING A/B POWER STATION (Vacancy No. 57/750).

Experience in operation E.H.T. switchgear, station auxiliaries and control large turbo-alternators an advantage. Duties, second assistant to Control Engineer. Salary Class L, Grade 14 = £830 plus £79 shift p.a. (Applicants to vacancy 57/615 need not re-apply.)

(b) DEPUTY STATION SUPERINTENDENT, BLACKWALL POINT POWER STATION (Vacancy No. 57/751).

Sound technical training with experience in operation, maintenance and administration of modern power station. Salary Class F, Grade 3 = £1,210 p.a.

(b) STATION SUPERINTENDENT, WEST HAM POWER STATION (Vacancy No. 57/752).

Wide experience power station operation, maintenance and administration, and should have lively sense of responsibility in management/employee relations. Salary N.J.M.C. Grade 5, Class B = £1,760-£1,960 p.a.

(b) DEPUTY STATION SUPERINTENDENT, WEST HAM POWER STATION (Vacancy No. 57/753).

Sound technical training with experience in operation, maintenance and administration of modern power station. Salary Class H, Grade 3 = £1,375 p.a.

(a) FOURTH ASSISTANT ENGINEER (Meter Section), TECHNICAL DEPARTMENT (Vacancy No. 57/754).

Duties comprise standardisation of precision indicating instruments, testing and commissioning of large power metering units and associated equipment. Acceptance tests on new machines, C.T. and P.T. testing, supervision of metering construction work, maintenance and installation of central indicating equipment, and compilation of technical reports and records. Salary Class AX/EX, Grade 5 = £860-£1,085 p.a.

Applications, quoting vacancy number, may be made on form obtainable from Divisional Secretary, Central Electricity Authority, London Division, P.O. Box 136, Generation House, Great Portland Street, London, W.1, and be received within 10 days of this advertisement. 7168

CENTRAL ELECTRICITY AUTHORITY

Eastern Division

APPLICATIONS are invited for the following posts in the SYSTEM OPERATION DEPARTMENT at Thames North Grid Control Area :—

THIRD ASSISTANT ENGINEER

Salary Class AX/EX, Grade 4, £895 × £25 to £1,020/£1,140 per annum, plus 10% shift allowance.

Applicants should preferably be qualified up to Graduate Membership standard of the I.E.E. and generating station experience would be an advantage.

The successful applicant will be required to undertake shift duties in the Grid control room.

FOURTH ASSISTANT ENGINEERS

Salary Class AX/EX, Grade 6, £710 × £25 to £835/£935 per annum.

Applicants should have qualifications to H.N.C. (Elect.) standard or should be completing studies to reach that standard.

Applicants should be prepared ultimately to undertake shift duties in the Area Grid control room.

Applications stating age, qualifications, experience and present position should be sent to the Controller, Central Electricity Authority, Eastern Division, West Farm Place, Chalk Lane, Cockfosters, Barnet, Herts, by 31st August, 1957. 7189

EASTERN ELECTRICTY BOARD

APPLICATIONS are invited for the following appointments. The successful candidates will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Northmet Sub-Area

BARNET DISTRICT (108/57R)

SECOND ASSISTANT ENGINEER (Ref. 716).

Candidates should have had a sound technical training and considerable experience in the design, construction and maintenance of underground and overhead distribution systems, including substations, at voltages up to 33 kV.

Salary N.J.B. Class F, Grade 7 (£885-£930), plus London allowance.

Apply by letter to L. F. G. Baker, District Manager, Eastern Electricity Board, 7c, High Street, Barnet, by 2nd September, 1957.

ST. ALBANS DISTRICT (109/57N)

THIRD ASSISTANT ENGINEER (Ref. 705).

Candidates should have had a sound technical training and suitable experience in the construction, operation and maintenance of H.V. and L.V. distribution systems including substations.

Salary N.J.B. Class F, Grade 9 (£790-£835).

Apply by letter to F. J. Drake, Assoc.I.E.E., Manager, Eastern Electricity Board, 107 St. Peter's Street, St. Albans, Herts, by 2nd September, 1957.

Norfolk Sub-Area

NORWICH DISTRICT (110/57R)

DISTRICT COMMERCIAL ASSISTANT (Agriculture).

Candidates should have had sound training in the electricity supply industry and subsequent wide experience of commercial practices. The person appointed will be required to concentrate on the development of energy and equipment sales in rural areas, and for this purpose a knowledge of farming equipment and the application of electricity to farming and horticulture is essential; an appreciation of farming practice and methods would be an advantage.

Salary N.J.C. Grade 3 (£680-£740).

DEMONSTRATORS (111/57R).

Candidates should have had domestic science training including electrical housecraft, should preferably hold the E.A.W. Certificate and be competent to plan and give cookery demonstrations, including lectures and advice to consumers on the use of domestic electrical appliances.

Salary N.J.C. Grade 1 (£500-£600), although progress beyond £540 will be subject to a certificate that the person concerned is capable of undertaking all the duties of the grade.

For Norwich District vacancies apply by letter, within 14 days, to the Manager, Eastern Electricity Board, Norwich District, 4, Duke Street, Norwich. 7225

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

ASSISTANT CONSUMERS' ENGINEER required at Blaenau Ffestiniog in the Caernarvon District.

Salary within range £635/£680 per annum (N.J.B. E/11).

Applicants should have had an engineering training and experience in dealing with installation work, consumers' supply enquiries and general commercial duties.

Appointment subject to medical examination. Pension scheme.

Application forms obtainable from the Manager, No. 4 Sub-Area, Electricity House, Rhostyllen, near Wrexham. Closing date, 28th August, 1957. 7207

ELECTRICAL TECHNICAL REPRESENTATIVE

OLIVER PELL CONTROL Limited, Cambridge Row, Woolwich, London, S.E.18, require two young qualified Engineers (age group 25-35) to sell coils, electro magnets, relays, solenoids and transformers to industry, one resident in the Bristol/Gloucester area and one north of the River Thames.

If you require a good salary and commission, and a permanent job in the sales team of a rapidly expanding organisation that keeps in front, send full details marked personally for the Sales Manager. 7193

SOUTHERN ELECTRICITY BOARD

Assistant Engineer (Maintenance)

OXFORD District of No. 2 (Newbury) Sub-Area. Salary N.J.B. Class H, Grade 11 (£790-£835 per annum). N.J.B. conditions of service.

The duties of the post will be to assist with the maintenance and operation of switchgear, transformers, cables and overhead lines up to and including 33 kV. The appointment will ultimately involve standby duties.

Applications on forms obtainable from the Sub-Area Secretary, 7, Oxford Road, Newbury, and returned to him in envelopes suitably endorsed not later than 2nd September, 1957.

Assistant Engineer (Maintenance and Operation)

Isle of Wight District of No. 3 (Portsmouth) Sub-Area. Salary N.J.B. Class E, Grade 10 (£685-£730 per annum). N.J.B. conditions of service.

The duties of the post will be to assist with the maintenance and operation of H.V. and L.V. distribution mains and substations and with minor construction work. The possession of suitable technical qualifications will be an advantage. The appointment will involve standby duties.

Applications on forms obtainable from the Sub-Area Secretary, Lower Drayton Lane, Cosham, Portsmouth, and returned to him in envelopes suitably endorsed not later than 2nd September, 1957.

Engineering Draughtsman

No. 3 (Portsmouth) Sub-Area Office, Sub-Station Section. Salary N.J.B. Schedule D, Grade 6 (£595-£715 per annum), commencing at a point dependent upon qualifications and experience. N.J.B. conditions of service.

Applicants should be qualified draughtsmen, and the successful candidate will be required to undertake, under supervision, the preparation and final layout of diagrams and drawings relating to mains, substation plant and equipment. Possession of suitable technical qualifications will be an advantage.

Applications on forms obtainable from the Sub-Area Secretary, Lower Drayton Lane, Cosham, Portsmouth, and returned to him in envelopes suitably endorsed not later than 2nd September, 1957.

The successful candidates for the above appointments will be required to contribute to the Central Electricity Authority and Area Boards (Staff) Superannuation Scheme, if eligible. 7205

EASTERN ELECTRICITY BOARD

Northmet Sub-Area. 98/57.R

Sub-Area Engineer (Ref. 691) (Revised Advertisement)

CANDIDATES should be Corporate Members of the Institution of Electrical Engineers and must have had extensive experience in the planning, operation, maintenance and construction of large distribution systems covering both urban and rural areas.

The post has wide engineering interest and involves responsibility for extensive capital and revenue works and the control of a large staff.

The appointment is superannuable and the revised salary will be in accordance with Class E, Grade 6 of the National Managerial and Higher Executive Grades Agreement (£2,500-£2,700) plus London allowance.

Applications to be forwarded to C. C. Hill, B.Sc.(Eng.), M.I.E.E., M.I.Mech.E., Manager, Northmet Sub-Area, Eastern Electricity Board, Northmet House, Southgate, London, N.14, so as to be received not later than Monday, 9th September, 1957.

Candidates who submitted an application in response to the previous advertisements need not re-apply. 7119

BRITISH KLOCKNER SWITCHGEAR LIMITED

Chertsey, Surrey

TECHNICAL SALES ENGINEERS required for London and Home Counties. Knowledge of motor control gear; sales experience preferred but not essential. Apply giving full particulars to—Managing Director. 166

Situations Vacant (continued)

MIDLANDS ELECTRICITY BOARD

Worcester and District Sub-Area

APPLICATIONS are invited for the following superannuable posts in the Bromsgrove/Redditch District. The appointments will be effective from 1st October, 1957, and the successful applicants will be located at Redditch.

DISTRICT ENGINEER.

The successful candidate will be responsible to the District Manager for all engineering matters, and should have had extensive experience in the planning, operation, construction and maintenance of H.V. and L.V. systems. Technical qualifications desirable. Salary £1,160/£1,235 per annum (N.J.B. Grade F.3).

SECOND ASSISTANT DISTRICT ENGINEER.

Experience necessary in the planning, operation and maintenance of high and low voltage underground and overhead distribution systems. Technical qualifications desirable. Salary £885/£930 per annum (N.J.B. Grade F.7).

SECOND ASSISTANT DISTRICT COMMERCIAL ENGINEER.

Applicants should have a sound technical training with wide practical experience in the sale and installation of domestic and commercial electrical equipment and the wiring associated therewith. Technical qualifications desirable. Salary £835/£880 per annum (N.J.B. Grade F.8).

Apply by letter within seven days, stating age, qualifications, experience, present salary and position, to Mr. R. Mallet, Sub-Area Manager, Midlands Electricity Board, Whittington, Worcester.

South Staffs. and North Worcs. Sub-Area

GENERAL ASSISTANT ENGINEER (METER DEPARTMENT) (HEADQUARTERS).

Duties will include laboratory work, substandard instrument calibration, testing of polyphase metering equipment, both in the test room and on consumers' premises, and the carrying out of special tests on other apparatus, including switchgear and relays. Technical qualifications desirable. Salary £590/£635 per annum (N.J.B. Grade L.18). Superannuable.

Apply by letter within fourteen days, stating age, qualifications, experience, present salary and position, to Mr. T. G. Keeler, Sub-Area Manager (Ref. CW), Midlands Electricity Board, P.O. Box No. 9, Toll End Road, Tipton, Staffs.

A. STEPHENS,
Secretary. 7224

POWER PLANT SUPERVISOR

A VACANCY exists with the Operations Branch of the Industrial Group of the United Kingdom Atomic Energy Authority at CHAPELCROSS WORKS, ANNAN, DUMFRIESSHIRE, SCOTLAND.

DUTIES: To be responsible, on shift, to the Shift Manager for the safe and efficient operation of power generating plant with associated E.H.V. and M.V. switchgear.

QUALIFICATIONS AND EXPERIENCE: Applicants must have served a recognised engineering apprenticeship and have had considerable experience in the operation of E.H.V. switchgears, turbo-alternators and steam plant. They should have a good knowledge of the electricity regulations and maintenance procedures concerning the safety of personnel. Possession of a Higher National Certificate in Electrical Engineering may be an advantage.

A period of training will be given at another works operated by the Industrial Group.

SALARY will be assessed within the scale £1,050-£1,270 p.a.

A contributory pension scheme is in operation.

An Authority house for renting by the successful candidate, if married, may be available in due course, or alternatively substantial assistance may be given towards legal expenses incurred in private purchase.

Send a postcard for an application form, quoting reference 2020, to the Recruitment Officer, United Kingdom Atomic Energy Authority, Industrial Group Headquarters, Risley, Warrington, Lancs.

Closing date, 9th September, 1957. 7145

SALES ENGINEERS

JOHNSON & PHILLIPS invite applications from men with suitable experience for positions as TECHNICAL ENGINEERS to sell one or more of the undermentioned products, principally to industrial and trade purchasers :—

CABLES.
CAPACITORS.
SWITCHGEAR.
TRANSFORMERS.

There are vacancies at Birmingham, Glasgow and Manchester branches.

Applications giving details of qualifications, experience and salary grouping, and indicating the preferred area, should be sent to the Sales Director, c/o Employment Department, Johnson & Phillips Ltd., Victoria Way, Charlton, London, S.E.7. 7192

A PROFESSIONAL ENGINEERING APPOINTMENT

in the field of

ELECTRICAL POWER SYSTEMS STUDY.

THE ENGLISH ELECTRIC COMPANY, Stafford, is interested in appointing a qualified Electrical Engineer or Physicist to conduct theoretical investigations and analytical studies into problems concerning electrical power systems.

Prospects are good. Analytically minded candidates who realise electrical power engineering presents a rewarding challenge are invited to apply to Central Personnel Services, 336/7, Strand, London, W.C.2, quoting Ref. ER.1218T.

May we add that Stafford is a pleasant county town not the centre of a heavy industrial area.

7209

TELEPHONE CABLE ENGINEER

for a wide range of duties associated with technical control in the manufacture of paper and thermoplastic telephone cables. The work involves the investigation of processes, the study and analysis of test data and the technical supervision of experiments.

Technical training should be to Higher National Certificate level in electrical engineering. Salary will be assessed generously according to age, qualifications and experience.

Prospects and conditions of employment are excellent, including bonus and superannuation schemes, five-day week, etc.

Please submit applications

to

Works Personnel Officer,
Reference P/2,
British Insulated Callender's Cables Limited,
Prescot, Lancashire.

6974

SENIOR SCIENTIFIC OFFICERS: SCIENTIFIC OFFICERS

THE CIVIL SERVICE COMMISSIONERS invite applications for pensionable appointments covering a wide range of scientific research and development in most of the major fields of fundamental and applied science. In Biological subjects the number of vacancies is small: individual vacancies exist in the Natural History Museum for candidates who have special knowledge of, or who are interested in, crystallography, taxonomic entomology, palæobotany, malacology, acarology.

Scientific Officers are urgently required for the Forensic Laboratories: for scientific examination of document and handwriting cases at Cardiff; for Chemists at Preston, Harrogate and in London. There is also a vacancy for a Senior Scientific Officer (Biologist) at Harrogate.

The Royal Naval Scientific Service require a Scientific Officer (male) for the National Institute of Oceanography to work on oceanic Cephalopoda.

Candidates must have obtained a university degree with first or second class honours in an appropriate scientific subject (including engineering) or in mathematics, or an equivalent qualification, or be otherwise qualified by high professional attainments. Candidates for Senior Scientific Officer posts must in addition have had at least three years' postgraduate or other approved experience.

AGE LIMITS: Senior Scientific Officers, between 26 and 31, but specially suitable candidates under 26 may be admitted; for Scientific Officers, between 21 and 28 during 1957 (up to 31 for permanent members of the Experimental Officer class).

SALARY (London): Senior Scientific Officers, minimum £1,190 (women £1,098); men's scale maximum £1,410. Scientific Officers, minimum £635; men's scale maximum £1,110. Women's pay above £635 slightly lower but being raised to reach equality with men's in 1961. Somewhat lower rates in the Provinces. 5-day week, generally.

Further particulars from

Civil Service Commission,
Scientific Branch,
30, Old Burlington Street, London, W.1,

quoting No. S.53/57 for Senior Scientific Officers and S.52/57 for Scientific Officers.

Interview boards will sit at intervals, as required. Early application is advised. 7213

JOSEPH LUCAS (ELECTRICAL) LTD.

Great King Street, Birmingham

AS a result of expansion of our road vehicle lighting development department to meet the growing demands of the motor industry we have vacancies for

ENGINEERS AND PHYSICISTS

of at least H.N.C. standard to work on the following projects. Experience or knowledge of photometric and electrical instruments desirable.

The design and development of vehicle lighting equipment and in particular the development of optical systems for future projects.

Development work on specific problems related to vehicle lighting equipment and the design of laboratory and factory control equipment for these products.

In addition there are vacancies for SENIOR DESIGNERS required to work in close co-operation with car designers and styling engineers on the design of lighting equipment for new car models. Experience in the design of pressed metal components for large quantity production desirable.

All of these positions carry attractive starting salaries and provide excellent prospects for advancement. Staff pension fund.

Apply in writing, stating age, qualifications and experience, to the Personnel Manager, Joseph Lucas (Electrical) Limited, Great King Street, Birmingham, 19, quoting reference PM/D/156.

127

CENTRAL ELECTRICITY AUTHORITY

Southern Division

APPLICATIONS are invited for the following positions :—

ASSISTANT ENGINEER
(Building Maintenance),
EARLEY GENERATING STATION
(S/13.939).

Applicants should have a good general knowledge of building and construction, be capable of levelling, and possess a knowledge of building regulations. Possession of certificates in building subjects of the City and Guilds Institute or a Higher National Certificate in Building will be an advantage.

The successful candidate will be required to supervise the repairs and maintenance of buildings at the station.

Salary N.J.B. Grade G.10, £790-£835.

SHIFT CHARGE ENGINEER,
POOLE GENERATING STATION
(S/13.940).

Applicants should possess technical qualifications admitting to corporate membership of a recognised professional institution, and have had previous operating experience involving responsibility in a large modern generating station with high temperatures and pressures and preferably with pulverised fuel equipment.

Salary N.J.B. Grade J.7, £1,065-£1,140.

GRADE 10 ENGINEER,
POOLE GENERATING STATION
(S/13.941).

The successful candidate may be called upon to perform the duties of a station shift control engineer, to assist on maintenance work, or to perform general station duties. Operating experience of modern generating station plant is essential.

Salary N.J.B. Grade J.10, £885-£930.

Applicants should possess a Higher National Certificate or its equivalent, and preferably possess or be studying for qualifications leading to corporate membership of an appropriate professional institution.

Special application forms for the above posts, obtainable from P. D. A. Oliver, Divisional Secretary, Central Electricity House, 111, High Street, Portsmouth, should be returned by 4th September, 1957. 7223

NEW ZEALAND MINISTRY OF WORKS

Professional and Technical Staff

THE Ministry of Works, New Zealand, invites applications for the following vacancies on the Permanent Staff. Positions, qualifications desired and commencing salaries are as follows:

MECHANICAL ENGINEERING DIVISION.

5. MECHANICAL AND ELECTRICAL ENGINEERS.
Corporate Membership of the Institution of Mechanical or Electrical Engineers, London, whichever is appropriate. Commencing salaries £895-£1,465 per annum.

6. BUILDING SERVICES ENGINEERS.
Corporate Membership of the Institution of Mechanical Engineers or of the Institution of Heating and Ventilating Engineers, London. Commencing salaries £895-£1,465 per annum.

7. ASSISTANT MECHANICAL, ELECTRICAL or BUILDING SERVICES ENGINEERS.
A University Degree in Mechanical or Electrical Engineering or Graduate Membership of the above Institutions. Commencing salaries £810-£1,000 per annum.

8. MECHANICAL, ELECTRICAL or BUILDING SERVICES DRAUGHTSMEN.
Ordinary or Higher National Certificate in Mechanical or Electrical Engineering, or equivalent examination, and at least three years' experience in draughting, design and calculations. Commencing salaries £720-£1,000 per annum.

Enquiries, mentioning this paper and quoting reference No. 3/74/133, also stating the type and number of position sought, should be addressed to the High Commissioner for New Zealand, 415, Strand, London, W.C.2. Full details of duties, experience desired, and general information on the conditions of employment in the New Zealand Public Service, together with application forms, will then be furnished. 6949

CENTRAL ELECTRICITY AUTHORITY

South Western Division

STAFF VACANCIES

(a) SENIOR ASSISTANT ENGINEER (Co-ordination), Generation Construction Department.
Superannuation scheme. Salary N.J.B. Class AX/CX, Grade 1, £1,330-£1,455/£1,525.
Candidates should have had a sound technical and practical training followed by wide experience in the construction of modern power stations, including programming and the control of site organisation. They should preferably be Associate Members of a recognised institute or possess similar qualifications.

(b) STATION CHEMIST, Castle Meads Power Station, Gloucester.
Superannuation scheme. Salary N.J.B. Class E, Grade 7, £835-£880.
Candidates should have had training up to H.N.C. level or equivalent in chemistry, and some experience of power station practice, and be capable of supervising the work of trainee chemists.
The station is modern, well laid out, of good efficiency, and affords attractive prospects for experience on high purity steam and water systems.
Laboratory facilities are good.

(c) ASSISTANT SHIFT CHARGE ENGINEER, East Yelland Power Station.
Superannuation scheme. Salary N.J.B. Class H, Grade 9, £885-£930 (plus 10% shift allowance).
Applicants should have had sound technical training and practical experience in a modern power station.

(d) STATION SHIFT CONTROL ENGINEER, Portishead "B" Power Station.
Superannuation scheme. Salary N.J.B. Class J, Grade 10, £885-£930 (plus 10% shift allowance).
Candidates should possess good technical qualifications and have had training and experience in the control and operation of steam generating plant and main switchgear in a modern power station.

Applications on form A.E.6/ACT obtainable from the Divisional Secretary, 26, Oakfield Road, Bristol, 8, should be completed and returned by 6th September, 1957. 7215

REED PAPER GROUP

invite applications for the post of

ENGINEER

in technical charge of a new (National Elliott 405) Electronic Business Computing Installation. The duties will consist of routine maintenance and fault rectification on the computer and its ancillary equipment.

The minimum qualifications required are H.N.C. or equivalent in electronics, and experience in radio or radar maintenance. Complete training in the special equipment will be given by the manufacturers.

The job will be located near Maidstone in Kent. It offers an attractive career to men who have had electronic and radar experience in the Services. Conditions of service are excellent, with a non-contributory pension scheme and assistance with house purchase in approved cases.

Write stating qualifications and experience to the Group Personnel Officer, Albert E. Reed & Co. Ltd., Larkfield, nr. Maidstone, Kent, quoting 58/B.

7171

SENIOR DESIGN DRAUGHTSMEN

and draughtsmen of other grades are invited by the Pye Group to apply for positions created by continued expansion in the light engineering industry.

Opportunities are offered to men with sound industrial training and experience in light mechanical or electrical engineering for rewarding work in a wide variety of electronic and electro-mechanical fields, including domestic radio and television.

Applications should be addressed in the first instance to the Chief Engineer, Pye Limited, St. Andrew's Road, Cambridge, quoting DD. 7221

SOUTH OF SCOTLAND ELECTRICITY BOARD

APPLICATIONS are invited for the undernoted positions in the Transmission Section of the Chief Engineer's Department :—

(1) FOURTH ASSISTANT ENGINEER, Galashiels Section (Ref. E.38/57).
(2) FOURTH ASSISTANT ENGINEER, Dunfermline Section (Ref. E.39/57).
(3) FOURTH ASSISTANT ENGINEER, Currie Section (Ref. E.40/57).
(4) FOURTH ASSISTANT ENGINEER, Tongland Section (Ref. E.41/57).
(5) FOURTH ASSISTANT ENGINEER, Headquarters, Glasgow (Ref. E.42/57).

All applicants should possess qualifications of not less than Higher National Certificate standard. Applicants for posts (1) and (2) must have at least two years' experience on 132-kV lines and switchgear, while applicants for posts (3), (4) and (5) should have had some experience in the electricity supply industry or with a firm of electrical manufacturers.

The positions are superannuable. Commencing salaries, with placing dependent upon experience, will be in accordance with Class AX/DX of Schedule B to the National Joint Board Agreement.

Posts (1) and (2):
Grade 5, £810/£1,010 per annum.
Posts (3), (4) and (5):
Grade 6, £710/£910 per annum.

Applications (quoting appropriate reference) should be submitted on the standard form, which may be obtained from the undersigned, and should reach this office not later than 31st August, 1957.

ANDREW A. WALLACE,
Secretary.

P.O. Box 173,
351, Sauchiehall Street,
Glasgow, C.2.
13th August, 1957. 7191

THE GENERAL ELECTRIC COMPANY LIMITED

Witton, Birmingham, 6

requires young qualified electrical engineers for work in connection with the preparation of tenders for control gear.

The work is interesting and covers a wide field involving steelworks, mining and industrial plant installations, and provides a good opportunity for young men of initiative to widen their experience and attain senior status.

Applicants should possess H.N.C. (Electrical) or equivalent, together with some knowledge of estimating and tendering.

Interviews in the strictest confidence will be arranged at any time to suit the convenience of applicants.

Adequate assistance is available to cater for change of district Generous salary levels are offeed. Salary at commencement depending on qualifications and experience.

Please apply with full particulars to the—

STAFF MANAGER

7170

BRITISH KLOCKNER SWITCHGEAR LIMITED

Chertsey, Surrey

ESTIMATOR for TECHNICAL SALES. Correspondence and capable of preparing control schemes involving automatic motor control gear. Experience essential.

CIRCUIT DIAGRAM DRAUGHTSMAN. Preferably experienced in preparing automatic control gear schemes.

Applicants to have O.N.C. (Electrical). Excellent opportunities with fast growing concern. Pension scheme. Apply to Managing Director, stating experience and present salary. 165

***Situations Vacant** (continued)*

EAST ANGLIAN REGIONAL HOSPITAL BOARD

Engineers and Draughtsmen

APPLICATIONS invited from suitably qualified persons for a range of (1) Mechanical and (2) Electrical Engineering posts for work in connection with development and design of a large new hospital and general hospital services for the whole region.

Posts are permanent and pensionable, providing scope in the entire field of hospital engineering covering surveys, reports, estimates, preparation of plans and specifications, and supervision of site works undertaken by contract in connection with (1) heating, ventilating, air conditioning, boiler plant, kitchens and laundries, water supplies, etc., and (2) lighting, power, call, radio, fire alarm, telephone and clock systems, lifts, emergency supplies and electrical services in connection with (1). Hospital experience, though desirable, is not essential.

All grades of staff are required ranging from Senior Assistants to Draughtsmen.

Applications giving full personal details of experience, qualifications, present salary, etc., with names of two referees, to Secretary of Board, 117, Chesterton Road, Cambridge, by 30th August, 1957. 7093

THE GENERAL ELECTRIC COMPANY LIMITED

Witton, Birmingham

requires

SENIOR DESIGN DRAUGHTSMEN

for control gear design and layout work in A.C. and D.C. electric traction.

High salaries are offered for these positions in a rapidly expanding department.

Draughtsmen without this specialised experience also required.

Please write with full particulars to—

THE STAFF MANAGER

7169

BROOKHIRST SWITCHGEAR LIMITED, CHESTER

have a number of interesting vacancies in both technical and sales departments for

APPLICATION ENGINEERS,
DEVELOPMENT DESIGNERS,
SALES ESTIMATING ENGINEERS
and
SENIOR ELECTRICAL DESIGN DRAUGHTSMEN.

Brookhirst has led the way in the application of motor control to nuclear power schemes, and these vacancies offer interesting work for young men interested in this field.

Previous experience in this type of work is not essential as training will be given, but applicants for posts of Engineers and Designers should hold a Higher National Certificate, whilst at least an Ordinary National Certificate in Electrical Engineering is required for Draughtsmen.

The company operates a pension scheme and canteen facilities are available. Five-day week. Assistance given towards cost of removal. Apply in writing, giving brief details of age, qualifications and experience, to the Personnel Officer, Brookhirst Switchgear Limited, Northgate Works, Chester, who will deal with the applications in complete confidence. 330

CENTRAL ELECTRICITY AUTHORITY

Eastern Division

APPLICATIONS are invited for the following appointment :—

GENERAL ASSISTANT ENGINEER, RYE HOUSE GENERATING STATION.

Salary Class G, Grade 14, £590 × £15 to £635 per annum, or Grade 15, £540 × £15 to £585 per annum plus 10% shift allowance.

Duties include assisting in the electrical control room and experience in the technical operation of electrical, boiler house and turbine house plant, testing, etc., in a generating station, and provide a suitable basis for promotion to higher technical grades.

Manual workers in skilled grades with suitable technical training will be considered. Previous experience in a generating station and/or technical training to the standard of the Ordinary National Certificate or its equivalent will be an advantage.

Applications stating age, qualifications and experience should be sent to the Controller, Central Electricity Authority, Eastern Division, West Farm Place, Chalk Lane, Cockfosters, Barnet, Herts, by 31st August, 1957. 7190

POST OFFICE

ASSISTANT ENGINEER. At least 25 posts for men to be filled by interview. Age at least 17½ and under 23½ on 1st March, 1957, with extension for service in H.M. Forces and, up to two years, for established civil service.

Candidates must have (i) General Certificate of Education passes in English Language and four other subjects, including two at Advanced level from Pure Mathematics, Applied Mathematics, Pure and Applied Mathematics, Physics, Chemistry; or (ii) an equivalent qualification, e.g., one based on Scottish Leaving Certificate, Scottish Universities Preliminary or Northern Ireland Senior Certificate examination; or (iii) a Higher National Certificate in Electrical Engineering; or (iv) a City and Guilds Final Grouped Course Certificate in Telecommunications.

Starting salary (London) £465 at 18, 19 or 20, £515 at 21, £650 at 25 or over, rising to £950. Somewhat lower in Provinces.

For particulars (including prospects) and application form write (preferably by postcard) to Secretary, Civil Service Commission, Burlington Gardens, London, W.1, quoting No. 291/57. Application forms should be returned by 12th September, 1957. 7142

ELECTRICAL/MECHANICAL ENGINEERING DESIGNER

THIS senior position with Merseyside company of medium size calls for rotating machine design ability, both electrical and mechanical, of a high order. Experience on control gear and systems, including electronics, is equally desirable.

The company, associated with a large group, expects to pay an attractive four-figure salary to a top-flight designer who is looking for a challenging position in which he can both develop and extend the company's existing range of products. These products are of small/medium size and special-purpose type.

First-class qualifications are necessary; adequate benefits are available. Applications, which should include age and salary indication, will be treated most confidentially.—Box 7027.

ELECTRICAL CONTROL OPERATORS

required for shift work in modern industrial generating station. Applicants must have power house experience, including load control and the necessary switching operations, and preferably also in parallel working with National Grid System.

Most attractive rates of pay and conditions of service.

Applications in writing giving age, qualifications and experience to the Labour Manager, THE CLAYTON ANILINE COMPANY Ltd., Clayton, Manchester, 11. 7161

PILKINGTON BROTHERS LIMITED

invite applications for a position in the Estimating Section of a medium-sized drawing office. The work covered by this section includes :—

1. The preparation of approximate estimates for buildings and plant from brief specifications and/or arrangement drawings.
2. Preparation of estimates for capital sanction from final arrangement and detail drawings. This work requires an intimate knowledge of the mechanical engineering trades and practices.
3. Valuation of plant and buildings for asset verification and fire insurance purposes.

Applicants should have some experience in one or more of these fields and should be qualified to O.N.C. standard.

Minimum starting salary for applicants having suitable experience and qualifications is £721 p.a. at 25.

The company operates a contributory pension scheme, assists with house purchase, and has excellent canteen, welfare and recreational facilities.

Applications giving brief details of career should be sent to the Chief Engineer, Pilkington Brothers Limited, Cowley Hill Works, St. Helens. 7032

DEVELOPMENT ENGINEER

EXPERIENCED Electrical Development Engineer, B.Sc., or H.N.C., required to take charge of research and testing laboratory situated 25 miles south of London.

Experience must comprise heavy current, medium-voltage range of rotating machines, transformers and control gear, and applicant must be capable of working on both practical and theoretical problems on his own initiative.

This is a permanent position in an expanding department with good future prospects. Existing holiday arrangements honoured. Pension scheme.

Apply, giving age, experience, qualifications and salaries received to :—

BRITISH GECO ENGG. CO. LTD.
Adelaide House, London Bridge, London, E.C.4

7046

BRITISH TRANSPORT COMMISSION

ELECTRIC TRACTION ENGINEER (Research) required in the office of the Commission's Chief Electrical Engineer (British Railways Division), London.

Knowledge all aspects railway electrification and ability to envisage potentialities of A.C. system and improvements of D.C. system; experience in other fields of engineering; honours degree in engineering and good working knowledge of scientific matters.

Responsible for general direction of research effort in railway electrification and co-ordination of research between universities, manufacturers and within the activities of British Railways.

Commencing salary up to £3,000 p.a. according to qualifications. Further advances dependent on degree of development of work.

Superannuation scheme. Certain free travel facilities. Medical examination.

Write, stating age, qualifications and experience, to Manpower Adviser, British Transport Commission, 222, Marylebone Road, London, N.W.1, within 14 days. 7143

SOUTH WALES SWITCHGEAR LIMITED

require for Branch Office in N.W. England:

(a) OUTSIDE TECHNICAL ASSISTANT to sell, mostly to Contractors and Industrialists, transformers, cables and switchgear. Technical qualifications preferably H.N.C. (Electrical). Car driver essential.

(b) DRAUGHTSMEN for Layouts and schematic diagrams.

Apply, stating age, qualifications, experience and salary required, to: South Wales Switchgear Ltd., 3, Hawthorn Lane, Wilmslow, Cheshire. 7100

Second Advertisement

COUNTY BOROUGH OF BLACKPOOL

Illuminations and Street Lighting Department

APPLICATIONS are invited for the superannuable post of SENIOR TECHNICAL ASSISTANT within the Qualified Engineering Assistants Grade (£707 5s. p.a. × £30 15s. to £861 p.a.).

Candidates should hold qualifications of Grad. I.E.E. standard and have experience of distribution networks and specification drafting.

Exceptionally, a candidate with suitable experience but lacking the above qualifications may be appointed on a lower commencing grade.

Forms of application, together with details of special conditions of service which apply, will be sent on application to the Illuminations and Public Street Lighting Officer, Illuminations and Street Lighting Department, Rigby Road East, Blackpool, and completed applications must be received by him not later than 10 a.m. on Thursday, 5th September, 1957.

ERNEST C. LEE,
Town Clerk. 7144

CITY OF BIRMINGHAM PUBLIC WORKS DEPARTMENT

Mechanical and Public Lighting Section

Vacancy for Electrical Engineer

SALARY Grade A.P.T. V (£814 17s. 6d. to £994 5s. per annum). Applicants should be Associate Members of the Institution of Electrical Engineers or hold equivalent qualifications.

Candidates should have experience in the design, specification and supervision of contracts for electric lighting and power installation in large buildings.

The post is permanent, superannuable and subject to a medical examination.

Applications stating qualifications, age and experience, and naming two referees, should reach the undersigned by the 21st September, 1957.

Canvassing disqualifies.

HERBERT J. MANZONI,
City Engineer and Surveyor.

Civic Centre,
Birmingham, 1. 7160

MUNICIPALITY OF BROKEN HILL, NORTHERN RHODESIA

Town Electrical Engineer

APPLICATIONS are invited from suitably qualified applicants fully conversant with electrical distribution, including operation, maintenance, planning and construction of future extensions.

Salary scale £1,320 p.a. rising by annual increments of £80 to £1,560 plus variable cost-of-living allowance now 21% of basic salary. The commencing salary will depend on qualifications and experience.

Superannuation fund, free furnished accommodation, or allowance in lieu, free passage to Broken Hill for the officer, his wife and children under 16 years, plus removal expenses up to £75.

A total of 52 days' paid annual leave and free return fares to coast every two years.

Write MERZ AND McLELLAN, ESHER, SURREY, for further information. 7074

THE LANCASHIRE DYNAMO GROUP

CHIEF ENGINEER AND MANAGER, SWITCHGEAR DIVISION,

required at their Oxted, Surrey, works to carry out an extensive re-design and development programme covering automatic control gear and allied products.

This appointment carries an attractive salary, with a good pension, and offers excellent prospects in a virile organisation situated in a Surrey beauty spot twenty-four miles from London with housing available.

Applications, which will be treated in confidence, should give full details of age, qualifications, experience and salary required, and should be addressed to :—

Managing Director
LANCASHIRE DYNAMO NEVELIN LTD.
Hurst Green, Oxted, Surrey

7083

CENTRAL ELECTRICITY AUTHORITY

Midlands Division

FOURTH ASSISTANT ENGINEER is required in the Transmission Department at Divisional Headquarters. N.J.B. service conditions, superannuable appointment, salary within Schedule B, Grade 5, £810 to £935, ultimately rising to £1,035 per annum.

Candidates should possess Higher National Certificate in Electrical Engineering or an equivalent qualification, and should have had some experience in operation and maintenance or construction of extra high voltage transmission lines and substations.

The selected applicant will be required initially to interchange duties between maintenance work and construction work in the various transmission sections and at Divisional Headquarters.

Apply on form AE6, quoting vacancy number 622MD, available from the Establishments Officer, 53, Wake Green Road, Moseley, Birmingham, 13, by 3rd September, 1957. 7217

CENTRAL ELECTRICITY AUTHORITY

Headquarters

Cathodic Protection

AN opportunity arises to join a specialist team associated with the Research Sub-Department of the Chief Engineer's Department at London Headquarters.

The duties consist of field work in relation to corrosion prevention on a wide range of buried and/or immersed plant, and are likely to involve a considerable amount of travel. Experience of corrosion engineering desirable but not essential, and candidates should have a degree or similar qualification in engineering or science.

Salary for the appointment would be within the scale of £870-£1,045 p.a.

Application forms, obtainable from the Secretary's Office (Establishments), Applications Section, Winsley Street, London, W.1, should be completed and returned not later than 14th September. Quote ref. ER/357. 7187

ASSISTANT DISTRIBUTION ENGINEER AND OVERHEAD LINE FOREMAN

required by BAHAMAS ELECTRICITY CORPORATION on contract for one tour of three years. Gratuity £100 a year. Free passages. Liberal leave on full salary.

ASSISTANT DISTRIBUTION ENGINEER (M2C/42380/EF). Salary £1,300 a year. Candidates must be Corporate Members of I.E.E. or possess H.N.C. (Electrical) and have wide experience of overhead and underground distribution up to 33 kV and of substation equipment.

OVERHEAD LINE FOREMAN (M2C/42381/EF). Salary £1,180 a year. Candidates must have experience of overhead line construction and maintenance up to 33 kV. Experience also of laying and jointing underground cables up to 11 kV desirable.

Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience, and quote the reference number shown against the post desired. 7182

FERRANTI LIMITED

Hollinwood, Lancs.

invite applications for appointments as

SENIOR RESEARCH AND DEVELOPMENT ENGINEERS

in the POWER ENGINEERING field, with particular reference to power transformers, high-voltage equipment, condenser bushings and impulse generators. Applicants must possess a first or second class honours degree in electrical engineering or physics, and must be capable of assuming individual responsibility for research and development projects. Salaries are based on an excellent scale and promotion prospects are good. A staff pension scheme and a dependants' insurance scheme are in operation.

Application forms can be obtained from T. J. Lunt, Staff Manager, Ferranti Ltd., Hollinwood, Lancs. Please quote reference FWG.

7029

CENTRAL ELECTRICITY AUTHORITY

Midlands Division

FOURTH ASSISTANT ENGINEER is required in the System Operation Department at Divisional Headquarters, Birmingham. N.J.B. service conditions, superannuable appointment, salary within Schedule B, Grade 6, commencing in range £710-£835, ultimately rising to £935 per annum.

The duties are of a general technical and statistical nature and applicants should have had a sound technical training and practical experience preferably in connection with system control. The possession of Higher National Certificate in Electrical Engineering or equivalent qualifications will be considered an advantage.

Apply, quoting Vacancy No. 621MD on form AE6, available from the Establishments Officer, 53, Wake Green Road, Moseley, Birmingham, 13, by 3rd September, 1957. 7216

PROJECTS ENGINEER

SIMON-CARVES LTD.
have a vacancy in the
PRECIPITATOR DIVISION
of their
CHEMICAL PLANT DEPARTMENT

for a PROJECTS ENGINEER, for projects work on electro-precipitators. Applicants should at least have an O.N.C. (Mech. or Elect.). Some experience on electro-precipitator practice an advantage but not essential. Someone used to similar mechanical and electrical projects work on equipment for steelworks, blast furnace plants or power stations would be suitable.

This post is permanent and pensionable. Salary depending on qualifications and experience.

Write, quoting ref. JO.39, to Staff & Training Division, Simon-Carves Ltd., Cheadle Heath, Stockport, Cheshire. 7146

ELECTRICIANS

required for
Power Station Contract Work
IN MIDLANDS.

London rates and out allowances paid.
Long-term contract.
Periodical travel facilities home.
Applications to

Employment Manager
JOHNSON & PHILLIPS LTD.
Charlton, London, S.E.7

7080

PLUMBER - JOINTERS

required for

Contract Work.

To work on cables up to 11 kV.
London rates and allowances paid.
Daily transport from London available for certain contracts if required.
Applications to

Employment Manager
JOHNSON & PHILLIPS LTD.
Charlton, London, S.E.7

7081

SENIOR TECHNICAL SALES ENGINEERS

required to introduce and sell fluid power transmission equipment to those manufacturers who make and want the best.

Applicants should have matriculation standard, have good engineering background, possess intimate knowledge of mechanical processes combined with electrical drives and transmissions; age approx. 40.

Give full details of education, qualifications and experience, stating branch of industries and firms concerned and present salary.—Box 7229.

***Situations Vacant** (continued)*

METROPOLITAN-VICKERS ELECTRICAL CO. LTD.

Shift Charge Engineer for Power Plant

APPLICATIONS are invited for the above pensionable staff position. Applicants must have experience in medium pressure water tube boilers and ancillary equipment of a total capacity of 240,000 lb. per hour. Experience with H.T. and L.T. substations, pumps and air compressors is desirable, and a knowledge of water treatment and testing is preferred but is not essential. All applicants must be prepared to undertake shift duties.

Write for application form, quoting reference O9, to Personnel Manager, Metropolitan-Vickers Electrical Co. Ltd., Trafford Park, Manchester, 17. 7162

MIDDLESEX COUNTY COUNCIL

Education Committee

LABORATORY STEWARD required for electrical engineering laboratories of Acton Technical College, High Street, Acton. Duties include the care and maintenance of equipment used in telecommunications and in electrical measurements, construction of apparatus to meet laboratory requirements, and general laboratory duties.

Salary Misc. V, £604 to £655 10s. if 26 yrs. or over. Prescribed conditions.

Write to Principal, giving full particulars of experience and qualifications, together with names and addresses of two referees, by 14th September, 1957 (quote V.887 ER). Canvassing disqualifies. 7218

ELECTRICAL DESIGNER

sought by established manufacturers in London with world market for special-purpose precision machinery. Exceptional prospects for qualified electrical engineer having practical experience, aged 30-40, who is possessed of the "creative spark."

Only applicant fertile in ideas, with original and inventive mind and receiving recognition in his present post on this account, need apply.

Write, in confidence, Personnel Manager, Molins Machine Co. Ltd., Evelyn Street, London, S.E.8.

7026

SIMPSON BROTHERS (OF HAPTON) LTD.

have the following vacancies.

FOREMAN for electrical assembly shop. Experience of light fabrication and machining an advantage.

FOREMAN for coil winding and transformer shop.

ASSISTANT to Production Manager for light electro-mechanical production.

TECHNICAL REPRESENTATIVE. Knowledge of control gear and transformers an advantage.

Accommodation available.

Apply by letter to Magneto Works, Hapton, Burnley. 6954

COMMERCIAL MANAGER

required by large manufacturers of electrical lamps and lighting equipment to take charge of their selling organisation in the **Midlands.** This is a senior appointment and applications will be considered only from men of wide sales experience and proved managerial ability. SALARY will be commensurate with age and experience. Pension scheme. Applications treated in confidence.—Box 7214.

SOUTH WALES ELECTRICITY BOARD

require a COMMERCIAL ASSISTANT in District 349 (Barry) in the Central Sub-Area of the Board.

Salary Class E, Grade 9 (£740/£785) of the N.J.B. Schedule.

Applications stating age, present position and salary, qualifications, experience, and three referees, should be addressed to the Secretary (Establishments Section), St. Mellons, Cardiff, to arrive not later than 9th September, 1957. 7222

A SERVICE engineer to maintain a number of H.T. plastic welding machines. Only applicants with practical servicing experience considered. Good salary, progressive position, age not important. Central London area.—Box 7149.

A WELL-known company exporting engineering products to Venezuela requires urgently a young man with some experience in the sale at home or overseas of electrical engineering products. The man concerned will be required to live in Venezuela. Generous terms offered to suitable man. Applications dealt with confidentially. Detailed applications to—Box 7148.

ASSISTANT electrical engineer required for West Indies sugar factory. Three-year contract, salary £1,000 to £1,100, free living quarters and medical attention, generous leave on completion. Applicants, who must have served a full apprenticeship and obtained their National Certificate in Electrical Engineering, should write with details of age, education, training, experience and marital status to—Box Y.802, c/o Streets, 110, Old Broad Street, London, E.C.2. 7194

ASSISTANT for design of electric motors and generators with National Certificate in Electrical Engineering or equivalent. Progressive position. — Higgs Motors Ltd., Witton, Birmingham. 7212

CHIEF electrical estimator required for small manufacturing concern in N. London dealing with interesting and varying range of electro-mechanical and sheet metal projects. Details to—Box 7163.

C.M.A. cable manufacturer requires sales representative for the Birmingham and Midlands area. One with established connections preferred. Write in confidence giving full details. Own staff informed.—Box 7150.

CIRCUIT draughtsmen required by firm manufacturing industrial control equipment. Commencing salaries up to £800 per annum for first-class men, but some less experienced draughtsmen required. Canteen facilities, pension scheme, holiday commitments recognised. Housing assistance later to approved cases. West Middlesex area. Write giving age, experience and full details to Box 7125.

DESIGN engineer (electrical) required by a young and expanding division of an internationally established engineering company, located in pleasant rural surroundings 25 miles from London. H.N.C. or equivalent preferred. For the design of oil-immersed metal rectifier equipment and transformers. Negotiation with customers and suppliers. Full responsibility from order to shipment. Commencing salary up to £900 per annum. Non-contributory pension scheme. Accommodation available shortly after engagement. Household removal expenses paid. Travelling expenses paid for interview. Please write, quoting ref. D.2, and stating relevant particulars to—Box No. 4 D. E7832, A.K. Advg., 212a, Shaftesbury Avenue, London, W.C.2. 7210

DESIGNER required for large power transformers up to 45 MVA at 132 kV. Good pension scheme and prospects in an expanding organisation. Reply giving details of experience, age and salary required to—Box 7195.

DRAUGHTSMAN wanted — electrical experience an advantage. Opportunity for ambitious man in Westminster office. Write age, experience and salary required. —Box 7126.

DRAUGHTSMEN. Excellent opportunities offered to electrical/mechanical draughtsmen. Established expanding company specialising in contactors, control panels and test rigs. 37½-hour week, two weeks' paid holiday after 10 months and sickness scheme. Write giving full details and salary expected.—Box 7211.

EAST Africa. Supervising engineer required for leading electrical contractor. Must be experienced in estimating and design of electrical installations. Write stating age and experience.—Box 7172.

ELECTRICAL contractors, North-West Kent area, require services of a part-time or free-lance estimator, experienced in general lighting, power and heating systems. All enquiries treated with strict confidence.—Box 9061.

ELECTRICAL contractors require experienced estimator-supervisor. No Saturdays. Superannuation scheme. Write in confidence stating experience and salary required.—Tyler & Freeman Ltd., 25, Floral Street, London, W.C.2. 7037

ELECTRICAL contractors, Eastern Counties, require supervising engineer to handle wiring contracts from estimating to final billing. Fine opportunity with big prospects leading to directorship for energetic young man (22-40) with sound practical and technical knowledge, able to interview and advise clients and also seek out business. Reply in confidence stating experience, age and commencing salary.—Box 9084.

ELECTRICAL contractors require experienced estimator for industrial power and lighting contracts. Young man, 25-35, capable of working on own initiative. Please reply in confidence, giving age, experience and salary required, to Electric House (Denton) Ltd., Law Street, Denton, Manchester. 7069

ELECTRICAL designer in charge small drawing office dealing with many aspects of design and application of medium switchgear, busbar systems, control boards, etc. This is unquestionably an important appointment for initiative and creative thinking in a small expanding manufacturing unit N. London. State details, approx. salary to—Box 7164.

ELECTRICAL draughtsmen for designing installations for power and lighting distributions required by consulting engineers in Manchester. Salaries up to £950 per annum according to experience.—Box 7197.

ELECTRICAL draughtsmen required by major oil company in the Middle East. Applicants, who should not be over 45, should preferably hold an H.N.C. or at least an O.N.C., and have at least 4 years' experience in an electrical engineering drawing office on work relating to installation and distribution schemes, power station layout, flameproof equipment, domestic and industrial lighting layouts. Two-year tours of duty followed by paid home leave. Salary £2,100 per annum net. Air passages paid. Write giving age, qualifications and brief career details to—Box ER.384, c/o 191, Gresham House, London, E.C.2. 7173

ELECTRICAL engineer. A large manufacturing company in the South-East of England has a vacancy for an electrical engineer to serve as assistant to the chief electrical engineer. Preferably with experience of D.C. supply and the maintenance of heavy plant. Applicants of around 35 years of age with sound qualifications and experience will be interested. Applications, which will be treated in strictest confidence, should state full details of qualifications and experience and an indication of initial salary expected. Assistance with housing will be given and a liberal pension plan is in operation. Write to—Box 7201.

ELECTRICAL engineer required by well-known engineers' representatives to develop transformer, capacitor and switchgear business in Scotland, to be located Glasgow area. Salary, commission and expenses, but working directorship available soon to suitable man, with salary, expenses and share of profits. An opportunity for man with a little capital, desirous of taking a share, initially small, but increasing over a few years, in an established business. State age, experience, present earnings, capital likely to be available over a period of five years, and whether car owner.— Box 9086.

ELECTRICAL engineering draughtsman required with some experience in the preparation of schemes for M.V. electrical distribution and illumination and electrical equipment of industrial buildings. Minimum technical qualification O.N.C. Minimum starting salary for draughtsman of H.N.C. standard is £747 p.a. at 25. Salary reviewed annually. Conditions include a contributory pension scheme, assistance with house purchase, family education schemes, a wide variety of recreational facilities, etc. Apply stating age, qualifications and experience to the Personnel Officer, Pilkington Brothers Limited, Cowley Hill Works, St. Helens, Lancashire. 7033

ELECTRICAL engineers with B.A. or B.Sc. degree required for work in connection with nuclear power stations by well-known consulting engineers in London. Applicants should have previous experience in the design and/or operation of large rating electrical plant, alternators and motors. Applications in the candidate's own handwriting, giving full details of education, qualifications and previous experience, to—Box 7234.

ELECTRICAL. First-class engineers, foremen and chargehands required by large London firm electrical engineers and contractors. Progressive positions. Write age, experience, references, etc.—Box 7068.

ELECTRICAL engineers for junior posts are required for experimental work on traction auxiliary motors and electro-pneumatic control schemes and equipment. There are possibilities of advancement for those who have obtained O.N.C. or reached S2 standard, and had some practical experience. Age limit 26. Write for further details to Personnel Superintendent, Westinghouse Brake & Signal Co., Ltd., Chippenham, Wilts, quoting ref. no. EQUIP/N/A1. 7127

ELECTRICAL installation draughtsmen for design of lighting and power schemes for all types of buildings required for consulting engineer's office in Reading/Oxford area. Appointments carry good salaries and pension scheme. Apply in writing giving full details of previous experience and technical qualifications to—C. W. Glover & Partners, Francis House, Francis Street, London, S.W.1. 7174

ELECTRICAL supervisor required for building installations in Aden. Salary £1,200/£1,500 plus allowances. Eighteen months' contract. Bachelor preferred. Must have electrical experience.—Box 7198.

ELECTRICAL wholesalers. Unique position offered to a really live and experienced representative to operate in the London and Greater London area. Must have good connections. A substantial existing turnover will be given to suitable applicant (own staff have been notified). Brief particulars in strict confidence.—Box 7175.

ELECTRICIANS, London rates.—Leonard J. Ive, 29, Clarendon Road, Watford (Phone 4030). 9070

ENGINEER required by electrical engineers in N.W. London. Applications are invited from men who possess experience in electric motor drives and control equipment, able to take charge of small design and drawing office, and capable of preparing good quality drawings. Familiarity with printing trade requirements essential.—Box 7049.

ENGINEERS are required for a manufacturing company in Johannesburg. (1) Switchgear engineer with sound background of protection schemes for development work on distribution at present up to 11 kV. (2) Control gear engineer with sound experience in design and application of motor control gear 1 to 2,000 H.P. The work is interesting and varied involving pre-estimate design and contracts engineering of switchgear projects. Previous experience required. Positions are permanent and pensionable, offering good prospects, good starting salary and excellent working conditions. (3) Engineer with commercial experience for preparation and submission of estimates and handling of contracts connected with manufacturing and selling of motors. Position is a senior one with commensurate salary and is pensionable. Applicants should state age and full details of experience and when at liberty to travel. Reply to—Box 7129.

ENSEL ELECTRIC Co. Ltd. require lighting and sales engineers. Experienced in planning and selling modern and commercial industrial lighting. Write full particulars of previous experience and salary required.—The Secretary, 218/219, Upper Street, London, N.1. 7199

ENSEL ELECTRIC Co. Ltd. require (1) shorthand typist; (2) general office clerk. No Saturdays, holiday arrangements respected, congenial conditions. Write fully with salary required to the Secretary, 218/19, Upper St., London, N.1. 7200

ESTIMATING. E. K. Cole Limited, Malmesbury, Wilts, have a vacancy for an estimator. The company is engaged on electronic equipment, and applicants should have had a wide experience in estimating this class of work and small quantity production. Good practical shop training is considered essential and an engineering apprenticeship desirable. Good salary will be offered and there is a possibility of housing accommodation being available to suitable applicants. Full welfare facilities and contributory pension scheme. Please apply in writing with details of education, training and experience to—Personnel Manager. 7196

EXPERIENCED meter designer required by Chamberlain & Hookham Ltd., Birmingham, 5. Written applications giving all details of electrical and mechanical design experience, age and technical status will receive careful consideration. An appropriate offer will be made to suitable candidates. 9066

FOREMAN electricians required by contractors in London W.C.2 area. Works in Greater London. Good prospects and superannuation scheme available for right men. All applicants will be interviewed.—Box 9065.

GENERAL superintendent (European) required for large well-established British-owned factory in Calcutta manufacturing a wide range of electric motors, transformers, switchgear, etc. Must have had considerable experience in charge of shops producing similar equipment. Knowledge of latest manufacturing methods and processes, and ability to organise operations for fast and economical production essential. The man appointed will be required to plan and instal an efficient piecework system in the factory where only day-work has been in operation up to the present, and good experience of the introduction and operation of piecework systems is essential. Age 30 - 40. Salary before tax, including dearness allowance, 3,300 rupees per month, plus travelling expenses, free passage to India, including wife and family, free accommodation and medical attention. Appointment will be subject to a 3-year renewable contract. Reply with names of references to Secretary, A.E.I. Overseas Ltd., Crown House, Aldwych, London, W.C.2. All applications will be treated in confidence. 7203

IMPERIAL CHEMICAL INDUSTRIES Limited, Plastics Division, has an immediate vacancy for an electrical draughtsman in the Chief Engineer's Department at Welwyn Garden City. Candidates must have served a recognised apprenticeship and should hold the Ordinary National Certificate. Experience of factory and general industrial installation work would be useful. An attractive starting salary will be offered to the selected applicant, beyond which there is plenty of scope for progressive remuneration. The appointment carries membership of the staff pension fund and a profit-sharing scheme is in operation. For married men special mortgage facilities can be granted towards house purchase, and assistance is given towards removal expenses. Temporary lodging allowance also available for married men. Apply giving full particulars to the Staff Manager, Imperial Chemical Industries Limited, Plastics Division, Black Fan Road, Welwyn Garden City, Herts. 7087

JUNIOR engineers required for the supervising of cable installation contracts throughout the country. Applicants must be capable of controlling rough labour and jointing staff, and taking as laid sketches to customers' requirements. Apply—Box 7230.

LONDON instrument assembly factory requires first class outstanding mechanical designer, preferably with experience in the design of small electronic apparatus. Comfortable 3-bedroom modern house immediately available within 20 minutes travelling distance of factory and easy access to shops, schools, etc. Commencing salary approx. £1,500 with scope for advancement and bonus for achievements. Only first-class men need apply. All applications will be treated in strict confidence. Write —Managing Director, Box 7237.

MACHINE shop superintendent required by large British-owned electrical engineering company's manufacturing plant in India. Applicants should be between ages of 30 and 40 years and have served a machine shop craft apprenticeship with subsequent experience in machining medium-sized products on batch production. Applicants should have risen to foreman or potential foreman status and be able to demonstrate machine tools and train labour. Experience of blanking presses, electro-plating and light non-ferrous casting desirable but not essential. The appointment is a senior one, would be for 3 years in the first instance, with passage, accommodation, medical expenses for self and family provided free. The gross salary before tax would be in the range of 1.800 and 2,250 rupees per month depending on age and experience. The appointment is pensionable. Full details should be sent to the Secretary, A.E.I. Overseas Ltd., Crown House, Aldwych, London, W.C.2. 7151

MERZ & McLELLAN have vacancies in their Esher office for electrical engineering draughtsmen, preferably between the ages of 25 and 32. Applicants should be experienced in plant layout work, cabling, etc., and experience of steam power station practice would be an advantage but is not essential. Salaries will be fully appropriate to applicants' experience, rising from about £780 per annum at age 25. Excellent working conditions. Five-day week. Pension scheme. Canteen. Apply in writing to Merz & McLellan, Milburn, Esher, Surrey. 7206

MANAGER assistant, 25-35 years, required by electrical contractor (med. size) engaged on building installations to handle all internal technical and office procedures. Good draughtsman able prepare schematic layouts and experienced estimating, buying, etc. Pension scheme. Excellent opportunity. State age, experience and salary required.—Box 7231.

MECHANICAL engineers with B.A. or B.Sc. degree required for work in connection with nuclear power stations by well-known consulting engineers in London. Applicants should have previous experience of the design and/or operation of steam turbines, pumps, high pressure steam and feed ranges, feed heating systems and pumps, and circulating water systems and plant, and compressor plants. Applications stating in detail age, education and previous experience in candidate's own writing to—Box 7233.

MECHANICAL layout draughtsmen possessing Higher National Certificate or equivalent qualifications required by well-known consulting engineers in London for work on nuclear power stations. Applicants should have previous experience in the layout of power station plant, high and low pressure pumps and pipework and turbine house and circulating water auxiliary plant. Applications in the candidate's own handwriting giving full details of education and subsequent training and experience to—Box 7232.

OPPORTUNITY for keen man (about 30) to take charge of sales office of old-established London firm in lighting industry. Experience in lighting fittings sales activities desirable but not essential. Applicants must have good knowledge of the electrical trade and be accustomed to dealing with users, contractors, architects, etc. Good prospects for keen organiser. 5-day week; pension fund. Write fully, stating age, experience and salary range.—Box 6964.

OVERHEAD linesmen required for wood pole H.T. and L.V. overhead lines in North East England. Permanency for conscientious men. Overtime and country allowance where applicable. Write giving particulars of experience, etc.—Graham Bros. (Electrical Engineers) Ltd., Zetland Place, Middlesbrough. 7236

POWER house superintendent required by the Baghdad Electricity Services for steam power station, medium pressure, 41 MW installed capacity, Babcock boilers and Parsons turbo-alternators. Three years' initial contract. Three months' leave after twenty-four months in Iraq. First class passage paid for successful applicant and family. Salary Iraqi Dinars 170 per month plus high cost-of-living allowance I.D. 22 to 25 according to number in family. Free house and heavy furniture provided. Age 35 to 45 years. Provident fund exists.—Box 7156.

SALES engineer with experience of motors and generators up to 1,000 h.p. or kVA. Progressive post with excellent prospects and pension scheme. Full details of age, education, training and experience to—Box 7050.

SALES engineer with good appearance and qualifications is offered a permanent position with increasing scope, good salary, according to age and experience, and pension scheme. Help with housing. Sound knowledge required of transformers and regulators. Apply Sales Director, Brentford Transformers Ltd., Crawley, Sussex. 7153

SALES manager required. Must have knowledge of overhead transmission equipment and connection with the Area Boards. Good permanent and progressive opening for young man under 40. Write in first instance—Bowthorpe Electric Co. Ltd., Crawley, Sussex, addressed to Sales Director. 7165

SALES representative required by lighting engineers and manufacturers. Applicants must have good knowledge of the electrical trade and be accustomed to dealing with users, contractors, architects, etc. Excellent prospects. Write stating age, experience, salary range and commission to — Morley's Electrical Services Ltd., 117, Hornsey Road, London, N.7. 7202

SITUATION available for senior switchgear designer experienced in the general mechanical and electrical design work associated with high-power switchgear and circuit breakers up to 132 kV. Previous experience on the lines indicated preferable, but design experience on associated equipment will be considered. Applications giving age, education and full details of experience, together with salary required, to the Personnel Manager, South Wales Switchgear Ltd., Blackwood, Mon. 7088

***Situations Vacant** (continued)*

STOCK control operator and order clerk required. Both posts are senior, well-paid positions offering scope in the future. Superannuation scheme, canteen and social club facilities. Experience of electrical wholesaling essential. Apply to Managing Director, Halsey's Electric Co. Ltd., Brandon House, Wyfold Rd., London, S.W.6 (Fulham 3355). 7052

STOREKEEPER for switchgear and conduit fittings, preferably able to drive. Good wages and excellent prospects for keen man. Write or phone—Leslie Maynard Ltd., 306a, Fulham Road, London, S.W.10 (Flaxman 3526). 158

SUPERINTENDENT engineer required for the Baghdad Electricity Services. Application invited from qualified engineers for new 8-MW diesel plant. Previous experience in similar position required. Monthly salary I.D. 150 plus high cost-of-living at present I.D. 20 per month. Passage paid first class, including wife and children under 16. Free house with heavy furniture. 3 months' vacation home on full pay after 2 consecutive summers in Iraq. Provident fund exists. Age limit 40.—Box 7157.

SUPERVISING engineer with estimating experience required by electrical contractors. 5-day week and superannuation scheme. Apply in writing stating experience and salary required. —Marryat & Place Ltd., 40, Hatton Garden, London, E.C.1. 7038

SWITCHGEAR sales engineers required, preferably with H.N.C. or higher qualifications and with experience in tendering for E.H.V. switchgear installations and power station auxiliary applications. Applications to give age, education and full details of experience, together with salary required, to—Personnel Manager, South Wales Switchgear Ltd., Blackwood, Mon. 7089

TECHNICAL assistant required. Comprehensive experience in electrical testing and examination of low and H.T. cables for voltages up to 33 kV or higher. Education to H.N.C. desirable. Apply in writing to — Personnel Manager, Telcon Works, Greenwich, London, S.E.10. 7176

TECHNICAL assistants (one senior, one junior) for the preparation of lighting schemes, illuminating engineering dept., old-established mfrs. of lighting equipment. 5-day week. Pension fund. State age and experience. —Chief Engineer, Technical Service Dept., Holophane Ltd., Elverton St., Westminster, London, S.W.1. 7183

TECHNICAL journalist. Metropolitan-Vickers requires assistant with technical background and some journalistic experience for press liaison work in publicity department (at Trafford Park, Manchester). Principal duties would be to collect and/or edit information for issue to the technical press, but some semi-technical or popular writing may also be required. The company's activities cover a wide range of mechanical and electrical engineering. Write giving details of education, training, experience, age, present position and salary to the Manager, Publicity Department, Metropolitan-Vickers Electrical Co. Ltd., Mosley Road Works, Trafford Park, Manchester, 17. 7154

TECHNICAL representative (National Certificate or equivalent qualification an advantage) required in connection with electrical repair and installation work, to operate in the Wolverhampton area. — The Midland Electric Installation Co. Ltd., Cyprus Works, Upper Villiers Street, Wolverhampton. 7166

TRANSFORMER dept. superintendent required by large British-owned electrical engineering company's manufacturing plant in India. Applicants should be between the ages of 30 and 40 years and have served an electrical engineering craft apprenticeship with subsequent experience of all aspects of the manufacture of distribution and power transformers in the range of 50 kVA to 2,500 kVA and up to 33 kV. Applicants must be thoroughly conversant with modern methods and have reached at least the position of foreman on similar work, and be able to demonstrate and train labour. The appointment is a senior one, would be for 3 years in the first instance, with passage, accommodation, medical expenses for self and family provided free. The gross salary before tax would be in the range of 1,800 to 2,250 rupees per month, including cost-of-living allowance, depending on age and experience. The appointment is pensionable. Full details should be sent to the Secretary, A.E.I. Overseas Ltd., Crown House, Aldwych, London, W.C.2. 7152

TECHNICIAN to take charge of inspection and quality control in electric lamp works. Salary around £700 p.a. depending on qualifications.—Ismay Lamps Ltd., Roden Street, Ilford 1153. 7235

THE REED PAPER GROUP have a vacancy for a junior instrument engineer for the chief engineer's staff at Aylesford Paper Mills. This is an interesting post for a man aged 25-30 in a rapidly increasing field in the paper industry, which includes investigation into process control problems in mills, supervision of installation and commissioning new plant; and the supervision and maintenance of extensive equipment together with general development work. H.N.C. or equivalent with apprenticeship is desirable. Electrical experience and experience in process control would both be advantages, and training will be given to a man who is seeking a career. Conditions of service are excellent with non-contributory pension and house purchase schemes. Apply with full particulars of age and experience to — Personnel Officer (Staff), Messrs. A. E. Reed & Co. Ltd., Aylesford Paper Mills, Larkfield, Nr. Maidstone, Kent. 7184

THE TELEGRAPH CONSTRUCTION & MAINTENANCE Co. Ltd. require an assistant branch manager for their Nottingham branch covering East Midlands and Yorkshire areas. Experience in sales of all types of paper and plastic cables essential. Excellent terms of employment and car provided. Write details to the Home Sales Manager, Mercury House, Theobalds Rd., Holborn, London, W.C.2. 7155

TRANSFORMER designer (senior) required. Applicant must have wide experience in design and manufacture of units up to 250 kVA. Promotion to directorship offered after qualifying period with commensurate salary and bonus. Housing accommodation if required. Replies will be treated in strict confidence.—Stewart Transformers Ltd., 75, Kilburn Lane, London, W.10. 7238

VACANCIES exist for first-class switchgear engineers for design and application of automatic control gear and L.T. switch fuseboards in the engineering and development departments of old-established electrical company at their Surrey works. Housing available, pension fund, great opportunities for young men with initiative and drive.—Box 7082.

WAREHOUSE assistant packer wanted by electric lamp distributors. Good wages, five days. Write fully with references, etc.—Box 7208.

WORKS manager to take complete control of manufacture of medium-sized electrical rotating equipment. Applicants (30/45) should be well versed with modern manufacturing processes, have drive, enthusiasm and preferably experience in manufacture of electrical apparatus. Write in confidence giving full details of experience, salary required and age.—Box 6956.

APPOINTMENTS FILLED

Dissatisfaction having so often been expressed that unsuccessful applicants are left in ignorance of the fact that the position applied for has been filled, may we suggest that Advertisers notify us to that effect when they have arrived at a decision? We will then insert a notice free of charge under this heading.

SITUATIONS WANTED

CHARTERED electrical and mechanical engineer with 18 years' executive experience out East desires position as overseas representative, travelling representative, export manager or contracts manager. Available early September.—Box 9068.

ELECTRICAL engineer, B.Sc., A.M.I.E.E., holding senior project situation, London, seeks position N. Somerset/Bristol area. Experienced design, contract, installation, etc., large industrial distribution, power, light, heat, vent. schemes.—Box 9083.

ENGINEER, M.I.E.E., retired (55), desires appointment. Managerial, personnel, welfare or technical representative. Background, works engineer large industrial concern/work study administration 8 years. Dorset or adjoining counties desirable.—Box 9082.

ENGINEER (36), M.T.T.I., recently returned from Australia, requires situation. Twenty years' extensive field service and repair shop experience in fault location, rewinding, redesign and repair of all types rotating electrical machinery and associated equipment.—Box 9064.

KEEN representative, age 40, 11 years' trade experience, desires change, London/Eastern Counties, manufacturer or wholesaler.—Box 9085

FOREMAN/supervisor electrician (34) seeks employment September anywhere in U.K. 18 years' experience factory maintenance and installation, engineering and plastics industries. Capable preparing layouts, etc. Present location Midlands. Refs. available.—Box 9090.

QUALIFIED elect./mech. engineer (47). Experienced chief engr. and works manager. Rotary machy., swgr., elect. appliances, fabrication, foundry. Pres. loc. Essex/London. —Box 9075.

SALES engineer, long experience in domestic apparatus, seeks position in Scotland or N.E. England. Managerial position at present time on salary of £1,350 p.a.—Box 9076.

SALES representative. Advertiser, of smart appearance with own car, seeks position of trust and responsibility with a manufacturer requiring a keen go ahead representative in the Midlands. 30 years' outdoor sales experience in the electrical trade (the past 19 years with leading E.L.M.A. manufacturer in Birmingham), contacts with electrical wholesalers, large works users, borough engineers and M.E.B. offices; used to working on initiative at top levels. Owing to amalgamation now seeks position elsewhere, where connections and contacts would be of service.—Box 7243.

SERVICE engineer, proficient in telephone and clock equipment, at present residing in Northants, requires post in Northants or Leicestershire. Willing learn other equipment. —Box 9073.

ARTICLES FOR SALE

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Stirling Area

D.C./A.C. Converting Plant is for sale, and further particulars as to where it can be inspected can be had on application to me.

4 BRUCE PEEBLES 250-kW Glass Bulb Type Mercury Arc Rectifiers complete with A.C. and D.C. switchgear and fully automatic in operation and control. Supply conditions A.C. 6,000 volts, 3-phase, 50 cycles, D.C. 460/230 volts, 3-wire.

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1 BRUCE PEEBLES 750-kW Motor Converter. Supply conditions A.C. 6,600 volts, 3-phase, 50 cycles, D.C. 460/490 volts. Complete with B.T.H., A.C., O.C.B. and D.C. starting resistance.

2 MATHER & PLATT 300-kW Motor Converters. Supply conditions A.C. 6,000 volts, 3-phase, 50 cycles, D.C. 460/500 volts. Complete with A.C. and D.C. switchgear.

2 MATHER & PLATT 150-kW Rotary Converters. Supply conditions A.C. 20,000 volts, 3-phase, 50 cycles, D.C. 440/470 volts. Complete with A.C. and D.C. switchgear and ancillary transformers.

2 MATHER & PLATT 300-kW Rotary Converters. Supply conditions A.C. 6,000 volts, 3-phase, 50 cycles, D.C. 460/500 volts. Complete with A.C. and D.C. switchgear and ancillary equipment. Both machines fully automatic in operation and control.

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The Board will not be bound to accept the highest or any offer.

JAMES G. CURTIS,
Area Manager.

Woodlands,
St. Ninians Road,
Stirling. 7239

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WESTERN AIRWAYS LIMITED, The Airport, Weston-super-Mare (2700), invite tenders for the sale of the following equipment :—

Two LISTER unequal-sized fully automatic Diesel Plants working in parallel, output 15 kW, 230 v. D.C., comprising :

18-2-33 LISTER Engine direct coupled to 10.5-kW Generator.

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Complete with control panel and batteries, all in first-class working order, except batteries.

The plant can be inspected, on application, at the above address. Plant sold subject to being dismantled, and to the rectification of any structural damage to plant building on removal from site, by purchaser.

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A BABCOCK & Wilcox water tube boiler will cut down your fuel costs ; we can supply from stock. Two 40,000 lb. evap., 220 lb. w.p.; one 25,000 lb. evap., 200 lb. w.p.; 3,000 lb. evap., 400 lb. w.p. ; Spencer Bonecourt boiler ; also Marine, Cornish vertical, etc.—Burford, Taylor & Co. Ltd., Boiler Specialists, Burtayco House, Church Street, Middlesbrough (Tel. Middlesbrough 2622). 122

A.C. and D.C. motors, generators, from stock.—Service Electric Co. Ltd., Honeypot Lane, Stanmore, Middx. (Edgware 5566/9). 91

A.C. and D.C. 1/- Slotmeters. Guaranteed 2 years, 2½-50 amps. From 50/-. Repairs and recalibrations. See Billiard: Tradex Meter Co., Surbiton (Tel. Elmbridge 4487). 169

ALTERNATORS from ½ to 675kVA in stock, single and three-phase, all voltages and frequencies. Guaranteed. Many unused. Send your requirements.—Fyfe, Wilson & Co. Ltd., Station Works, Bishop's Stortford. 162

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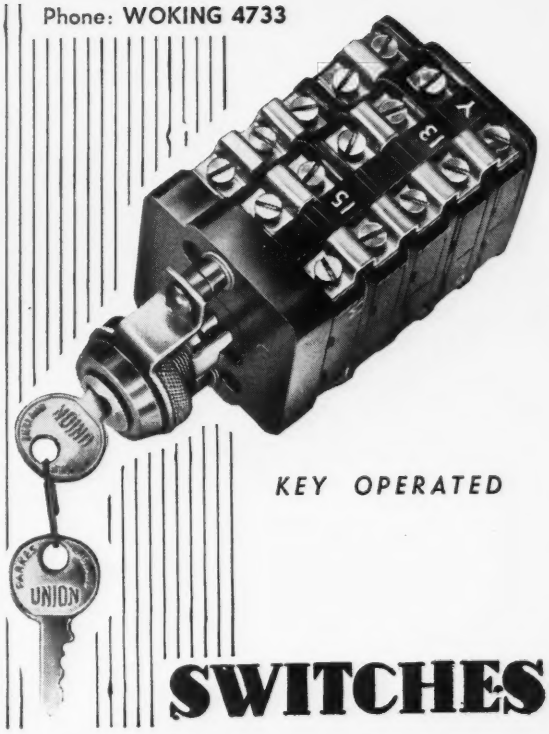

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INDEX TO ADVERTISERS

Aberdare Cables Ltd. 85
Aero Research Ltd. 87
Airedale Electrical & Mfg. Co. Ltd. 21
Alloy Wire Co. Ltd. 66
Arcolectric Switches Ltd. 19
Ashley Accessories Ltd. 39
Atlas Lighting Ltd. 58

Backer Electric Co. Ltd. 82
Barns, W., & Son (Holloway) Ltd. 97
Belling & Co. Ltd. 12
Belling & Lee Ltd. 95
Bill Switchgear Ltd. 3
Birch, H. A., & Co. Ltd. 74
Blickvac Engineering Ltd. 118
Bound Brook Bearings Ltd. 14
Bray, E. N., Ltd. 41
British Insulated Callender's Cables Ltd. 81
British Switchgear Corporation Ltd. 116
British Thomson-Houston Co. Ltd. 5
Brook Motors Ltd. 63
Broxlea Products Ltd. 118
Bryce Electric Construction Co. Ltd. 27
Bulgin, A. F., & Co. Ltd. 67
Bulpitt & Sons Ltd. 54
Burdette, A., & Co. Ltd. 72
Burn, Geo., Ltd. 19

C and R Fiashers Ltd. 74
Carter & Co. (Nelson) Ltd. 30
Chamberlain & Hookham Ltd. 102
Churchouse, C. M., Ltd. 33
Clarke, H., & Co. (Manchester) Ltd. 56
Cohen, George, Sons & Co. Ltd. ... 6
Cox-Walkers Ltd. 98
Crater Products Ltd. 115
Cressall Mfg. Co. Ltd. 76
Crofts (Engineers) Ltd. 80
Crompton Parkinson Ltd. 93
Cryselco Ltd. 15
Cuxson, Gerrard & Co. Ltd. 20

Daly (Condensers) Ltd. 52
De La Rue & Co. Ltd. 61
Dorman & Smith Ltd. 8
Dzus Fastener Europe Ltd. 44

Electric Depôt Ltd. 20
Electric Elements Co. 98
Electrix Ltd. 74
Ellison, Geo., Ltd. 65
Enfield Cables Ltd. 46
Engineering, Marine, Welding & Nuclear Energy Exhibition 88
English Electric Co. Ltd. ..... 50 & 79
Evans, F. W., Ltd. 20
Everett Edgcumbe & Co. Ltd. 70

Ferranti Ltd. 45
Fischer Bearings Co. Ltd. ..... Cover 3
Fitter & Poulton Ltd. 29
Fry's Metal Foundries Ltd. 90

Gaskell & Grocott Ltd. 118
Geipel, W., Ltd. 29
General Electric Co. Ltd. 17
Genristo Ltd. 44
Gent & Co. Ltd. 22
Gilby-Brunton Ltd. 98
Godwin, H. J., Ltd. 33
Greenwood's & Airvac Ventilating Co. Ltd. 34
Grey & Marten Ltd. 100

H.V.E. (Electric) Ltd. 66
Hackbridge & Hewittic Electric Co. Ltd. 11
Heatrae Ltd. 1
Henley's, W. T., Telegraph Works Co. Ltd. ..... 36 & 37
Hirst Electronic Ltd. 16
Hoffmann Mfg. Co. Ltd. 100
Honeywell-Brown Ltd. 48
Howells (Electric Motors) Ltd. 68
Hyde, J. B., & Co. Ltd. 100

I.A.C. Ltd. 97
Imperial Chemical Industries Ltd... 7
Insuloid Mfg. Co. Ltd. 78

Johnson, Matthey & Co. Ltd. 24

Kempston Electrical Co. Ltd. 74
Kenwood Mfg. Co. Ltd. 76
King, Geo. W., Ltd. 9

Laurence, Scott & Electromotors Ltd. ..... Cover 1
Lindsay & Williams Ltd. 88
Litholite Insulators & St. Albans Mouldings Ltd. 98
Logan, W., & Co. Ltd. 34
London Electric Wire Co. & Smiths Ltd. 53
Low Moor Alloy Steelworks Ltd. ... 83

M.T.E. Control Gear Ltd. 18
Maclaren, R., & Co. Ltd. 97
Martindale Electric Ltd. 38
Metropolitan-Vickers Electrical Co. Ltd. ..... Cover 4 & 25
Metway Electrical Industries Ltd. 29 & 47
Monmer Foundry Ltd. 60
Morgan Crucible Co. Ltd. 10

Nalder Bros. & Thompson Ltd. 99
Neo Electrical Industries Ltd. 118
Nettle Accessories Ltd. 84
Newton Bros. (Derby) Ltd. 82
Northern Aluminium Co. Ltd. 32

Ormond Engineering Co. Ltd. 26
Oscard, James, & Co. 29
Ottermill Switchgear Ltd. 71

P. & B. Engineering Co. Ltd. 42
Painter Bros. Ltd. ..... Cover 2
Partridge Jones & John Paton Ltd. 40
Partridge, Wilson & Co. Ltd. 59
Parvalux Ltd. 66
Permali Ltd. 13
Pirelli-General Cable Works Ltd. ... 49
Portable Furnace & Patents Co. 116
Power Centre Co. Ltd. 117
Precision Rubbers Ltd. 16

Quicksilver Tube Mfg. Co. 20

Ratcliff, J. F. (Metals) Ltd. 63
Record Electrical Co. Ltd. 89
Reed Corrugated Cases Ltd. 35
Renold Chains Ltd. 33
Revo Electric Co. Ltd. 77
Richardsons Westgarth (Hartlepool) Ltd. 57
Robinson, D., & Co. 64
Robinson, L., & Co. Ltd. 101
Ross Courtney & Co. Ltd. 23
Rowlands Electrical Accessories Ltd. 63
Runbaken Electrical Products 64
Ryman, F., Electrical Ltd. 52

Salter, Geo., & Co. Ltd. 2
Santon Ltd. 92
Sax, Julius, & Co. Ltd. 64
Simmonds & Stokes (Niphan) Ltd. 52
Simplex Electric Co. Ltd. ..... 43 & 94
Sims, F. D., Ltd. 101
Smith, Herman, Smithlite Ltd. 101
South Wales Switchgear Ltd. 86
Southern Instruments Ltd. 60
Sperryn & Co. Ltd. 30
Square D Ltd. 28
Stadium Ltd. 115
Standard Telephones & Cables Ltd. 31
Stockfield Mfg. Co. Ltd. 55

Taylor, Armand, & Co. Ltd. 23
Taylor, S., & Co. Ltd. 4
Terry, Herbert, & Sons Ltd. 96
Thermostatic Controls Co. 115
Thompson Bros. (Engineers) Ltd. ... 55
Transformer & Electrical Co. Ltd. ... 76
Transformers & Rectifiers Ltd. 47
Trumeter Co. Ltd. 34
Tudor Accumulator Co. Ltd. 73
Tungstone Products Ltd. 64
Turnock, Geo., Ltd. 52

Universal Electrical Co. 118

Veritys Ltd. 62
Vincent Switchgear Mfg. Co. Ltd... 60
Volex Electrical Products Ltd. 51

Wades (Halifax) Ltd. 26
Walters, Austin, & Son Ltd. 60
Wandleside Cable Works Ltd. 116
Warmex Ltd. 74
Wellings, Male & Co. Ltd. 66
Western Diecasting Ltd. 34
Westinghouse Brake & Signal Co. Ltd. 75
Westminster Engineering Co. Ltd... 20
Whitehouse Industries Ltd. 91
"Wireless World" 56
Wolf Electric Tools Ltd. 59
Wootton & Co. Ltd. 55

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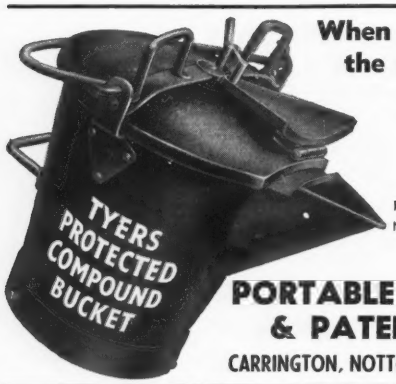

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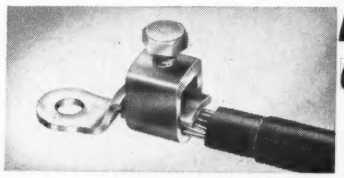

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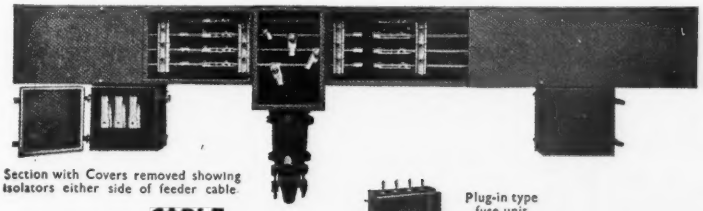

Section with Covers removed showing isolators either side of feeder cable

BUSBAR SYSTEMS

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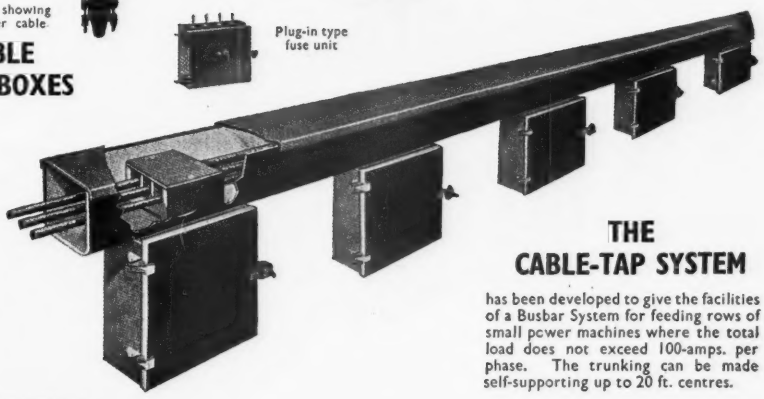
CABLE BOXES



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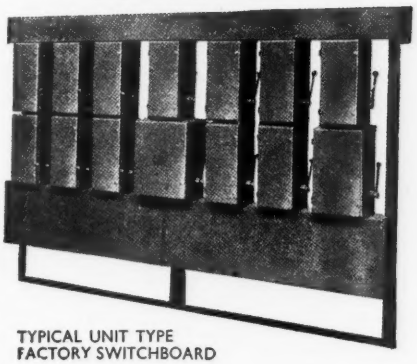
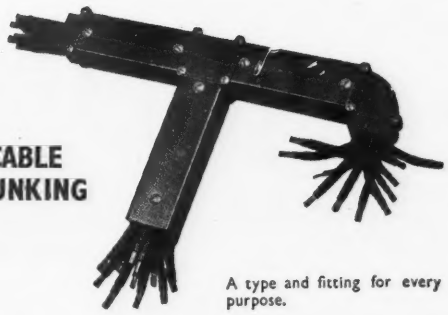
SWITCHBOARDS



TYPICAL UNIT TYPE FACTORY SWITCHBOARD

CABLE TRUNKING



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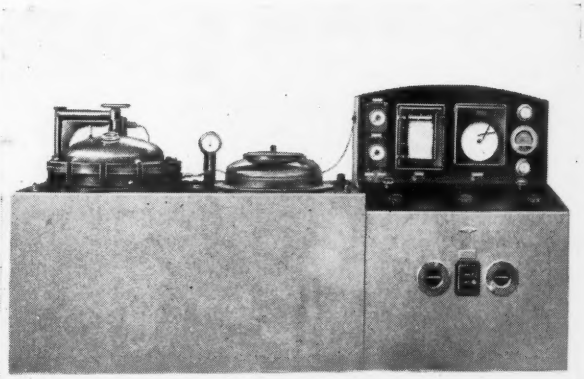

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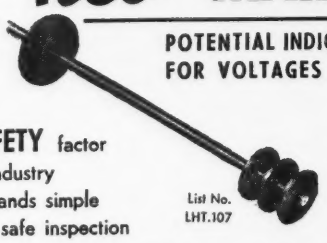

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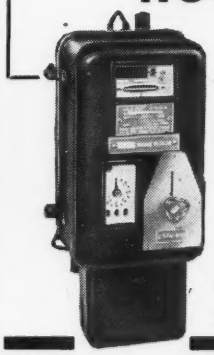

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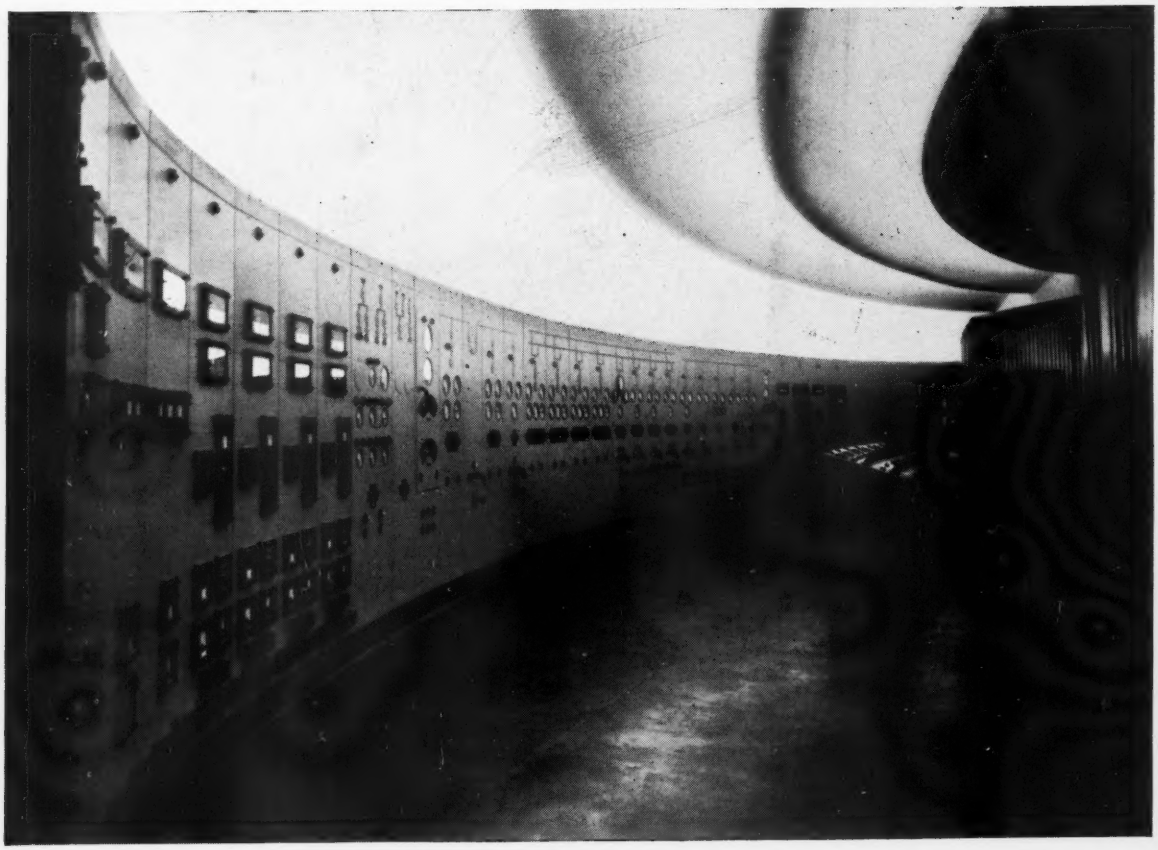

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